GAS JOURNAL

LIGHT ⁘ HEAT ⁘ POWER ⁘ BYE-PRODUCTS

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Editorial Notes.

Fuel Brought Home.

On Friday evening last, Sir David Milne-Watson broadcasted an address from the London Station of the B.B.C., taking as his subject "Planning the World's Fuel." During the past three weeks, a great deal has been published in the Daily Press regarding the World Fuel Conference; but we venture to think that not one in a thousand of the lay public has read the highly technical reports, albeit the attention of many may have been gripped by a few sensational items—the work of propagandists—such as the "farthing a unit" announcement which preceded by some days the reading of Mr. Sloan's paper at the Conference. Thus it is a feather in the cap of that not always benignly used body, the B.B.C., that they should have arranged so fitting an epilogue to an event of supreme importance, and should have secured the services of one so well qualified to point the moral. Sir David spoke only for about twenty minutes; but in that brief space of time he spread before the thousands of listeners an able epitome, in language they understood, of the deliberations and objects of the Fuel Conference. They learned what fuel meant in the broad interpretation of the present day; they had impressed upon them the need for co-ordination and development of the world's fuel resources; and they heard—probably for the first time without trimmings—the difference between high-temperature and low-temperature carbonization. Sir David pointed out, too, that every advance in the scientific and efficient treatment of fuel tends to economy all round, and therefore that the user of fuel must ultimately benefit, even beyond the enormous advantage of living in a clearer atmosphere.

The address was written for the benefit of the "man in the street;" and yet there were lessons in it for men in the gas and other fuel industries. All must have been impressed by the moderation and breadth of view demonstrated by the President of the National Gas Council, whose spoken word should give the final quietus to any of the low-temperature and coke-oven enthusiasts who still think the gas industry a passive resister to their advances. There emerged from the address the need for keeping an open mind, in the one case while low-temperature experiments are pushed ahead, and in the other till the findings of the Area Gas Supply Investigation are known. But upon one thing, said Sir David, the minds of all are made up—that the day of the small undertaking, whether coke, gas, or steel, is over, and that larger units are essential if the best results and the full advantages of our technical knowledge are to be obtained. We ourselves have long advocated the policy of linking-up in the gas industry, and we welcome the signs of an extending interest in that direction—among the latest examples are Tunbridge Wells and Crowborough, and Redhill and Dorking. It would be well if somewhere a magic circle could be completed, to demonstrate what a town gas "grid" can do in efficiency and public service.

"Business—Ancient and Modern."

The title of an address that forms part of the programme of the "B.C.G.A." Annual Conference, which opens at York on Monday, Oct. 22, strikes a very appropriate note, for "ancient and modern" do indeed find themselves in close juxtaposition when the commercial administrators of the gas industry meet within the walled city of York. The programme of the conference itself bears evidence of the modernness of the ideas and policy of the Association; and no one needs to be told how ancient are the city's gates and towers and walls. But new ideas and progressive policy will not startle the burghers of the ancient city; for the gas industry is represented there by one of the most alert, active, and far-seeing Companies. At the head of the Directorate is an able man of affairs whose quality will, we are certain, be richly displayed in his Presidential Address to the conference; and at the head of its staff is one of the keenest spirits and best-informed minds in the gas industry, who always compels us to think whenever he opens, or contributes to, a discussion. A programme that has at its commencement an address by Mr. Alfred Procter, and towards its end a paper by Mr. Harold Bloor, awakens interest and arouses anticipation at once; and there is much more that assures beforehand the success of yet one more of these always successful, interesting, and inspiring gatherings.

On the Monday evening, following a reception by the President in the Assembly Rooms, there will be a lecture by Sir William Arbuthnot Lane, whose fame in the world of surgery and of preventive medicine needs no emphasis to our readers. It is indeed of good omen for the continued prosperity of the industry that one eminent medical man after another—Sir Henry Gauvain, Sir Bruce Bruce-Porter, and now Sir William Arbuthnot Lane—should readily come forward to bear their testimony to the services which gas is rendering to the cause of national health and happiness. Then on the Tuesday morning, after a civic welcome by the Lord Mayor of York, and the Presidential Address of Mr. Procter, members will have the pleasure of hearing again Sir Lawrence Weaver on "Art in Industry," but this time not so much on the general lines on which he discoursed to us so charmingly, and withal so caustically, and in such stimulating fashion, at Liverpool, but on the very practical and specific question of gas fire design. We do not hesitate to say that this address by Sir Lawrence will be of outstanding interest and value. We know something of the work and thought and enthusiasm he has expended upon its preparation, and the considered opinions of a man of his quality and authority will be of great value to the industry. We would travel a long way to York, if for nothing else but to hear him. And we would travel far, too, to hear Mr. Ernest Hunt talk on "Business—Ancient and Modern," or any other subject upon which he elected to speak; for we heard him address the annual gather-

ing of the Gas Salesmen's Circles a year ago, and that was sufficient to make us ready members of any audience he might address. We advise all our readers who can get to York to be at "The Merchant Adventurers' Hall" (delightful name for a place of meeting of the salesmen of our industry to-day) on the afternoon of the conference Tuesday.

Later that day visitors will be entertained at dinner by the York Gas Company, and then comes the final session on the Wednesday morning. Mr. Bloor's talk on "Local Publicity—with special reference to Showrooms" will be of great interest and value—especially what he may have to tell us about his peripatetic showroom. The annual statement of the Executive Chairman will probably be to the point, if commendably brief, and will doubtless inform us of the progress of the appeal for increased contributions to the publicity fund. Then, after the members have considered and approved the amended rules—amended in no vital particular, but so as to bring them up to date—the session will become a joint conference of members of the National Gas Council and the Association to discuss the tremendous subject of "Methods of Charge." That will be a private session, at which everyone can talk freely, knowing that no reporter's pencil is busy, and that no report will appear. While we do not believe in secret conferences as a general rule, we realize that there are occasions—and this is one of them—on which absolute freedom of speech, with no reporter present, is valuable and expedient. We hope the discussion will prove of definite and immediate value to the industry. We have no doubt whatever that the "B.C.G.A." conference itself will, like each of its predecessors, be of immediate interest to all who attend it, and of permanent service to the undertakings which they represent.

Seals of Efficiency.

Our readers will be interested in an account in later columns of the dedication ceremony of the American Gas Association's new Testing Laboratory which took place at Cleveland last month. Financed by the gas industry of the United States, and obtaining part of its revenue from testing fees, the Laboratory enjoys the hearty support of the leading manufacturers and the enthusiastic collaboration of most of the gas companies in the country. Indeed, there are few undertakings now who refuse to pledge themselves to deal only with appliances tested and approved by the Laboratory, and bearing the "Blue Star"—the symbol of high thermal and working efficiency, and a guarantee of complete safety in use. Characteristically, the speeches of our American friends at the ceremony were interspersed with statistics; and Mr. R. W. Gallagher, who is Chairman of the Laboratory Managing Committee, mentioned that since operations were commenced towards the close of 1925 no fewer than 11,000 appliances have been approved, 30,000 tests on "mixed gas research" have been conducted, and Laboratory Inspectors have travelled 25,000 miles. These facts afford sufficient indication of the virility of the organization, and of the astounding success of the work; and —herein lies the essence of the endeavour—they show that the gas consuming public of America are realizing what the "Blue Star" means to them in their own homes and in their daily lives. We congratulate the American Gas Association on the outcome of their enterprise, and compliment them on their choice of hall-mark. Blue, the aristocrat of colours, is appropriate to gas—the aristocrat of public service.

It was singularly fitting that Mr. J. G. Clark, who is attached to the Gas Light and Coke Company in a capacity which includes work almost on parallel lines to that which is being undertaken in Cleveland, should have been present at the dedication ceremony. "We have," he observed, "a very good commodity to sell—one of the finest fuels the world has ever known. It is efficient, economical, safe, and healthy, with proper use." The crux of the whole matter is, of course, that it should be utilized properly; and the attainment of this ideal depends on the co-operation of engineer and chemist. In England the problem is being solved at Watson House and in the laboratories of the leading gas companies and of the manufacturers of gas appliances; but we have no doubt that the public's sympathy would be more readily kindled if approved apparatus bore some sign of merit. Realizing the moral value of such a symbol, the New South Wales Commercial Gas Association have created a central Testing Laboratory, which is now in vigorous operation. Appliances which emerge successfully from the ordeal of stringent investigation are stamped with a "Seal of Efficiency;" and every gas company member of the Association has agreed that no apparatus which fails to pass the tests will be offered for sale. Perhaps before long in England we shall have some co-ordinated system which will result in a British gas industry's seal of efficiency.

An Oriental Romance.

It has ever been our aim to acquaint our readers with the progress of the gas industry not merely in this country, but generally throughout the world; and it is gratifying to have been able to publish in the last issue of the "Journal" a singularly interesting account of what has happened to the Japanese gas industry since its comparatively recent inception in 1872 to the present day. This brief history was presented to the World Power Fuel Conference by Sakura Okamoto, with the authority of the Power Association of Japan; and it constitutes a veritable Oriental romance. The evolution of gas in Japan forms a vivid contrast to the steady growth of the industry in Great Britain, though to-day both countries are happy in the knowledge that never before has gas been so surely founded, and that at no previous time have the prospects of future expansion been brighter.

The advent of gas in Japan coincided with the flooding of the country with western ideas, and as a result full encouragement was given to the development of the new illuminant. Enthusiasm for western civilization, however, could not, over night, transform social conditions which had seen comparatively little change for centuries; and it is not surprising that at the end of 1877 the number of gas consumers in Tokyo was only nineteen. Even by 1903 there were only five gas companies in Japan. The expansion stage, however, was at hand; and the intense activity in all business and industrial circles following the Russo-Japanese war was reflected at once in the growth of the gas industry—to such an extent, in fact, that by 1914 the consumers numbered 643,469. Then the industry had to face a very grievous period of depression. During the early part of this century the development of water-generated electricity was phenomenal; and after the year 1914 the major load of the gas industry—public lighting—quickly passed into the hands of the electricity suppliers. This transition, moreover, occurred at a period of serious economic disorder resulting from the Great War; and it is small wonder that a state bordering on panic was brought about. Dissolution of gas business, or amalgamation with electrical interests, became the topic of the day. Indeed, in 1917 and 1918 twenty-three companies liquidated, and eighteen amalgamated with, or were purchased by, other concerns. Fortunately, these parlous conditions were short-lived; and the industrial depression which followed the end of the war had little influence on an industry already almost broken under the strain of hardship. Actually, 1920 heralded an age of recovery. The industry modified its operations, and concentrated on the heating load; and to-day gas is being used more and more for cooking in cafés and restaurants, and instantaneous water heaters and small fires are enjoying an ever-increasing popularity. Moreover, though the application of gas to industry is still in an early stage of development, its possibilities have been realized to such an extent that in 1926 the industrial load of two gas companies represented over 40 p.ct. of the total output; that of four companies over 30 p.ct.; and that of three over 20 p.ct. And as for the profit of the business, thirty-six out of seventy companies are now able to pay annually more than 10 p.ct. dividend.

The hardships which the industry had to encounter had one extremely important beneficial result—they necessitated the closest possible attention to economic working. Old plants were either scrapped or brought up to date; and the former practice of dumping coke and tar into

rivers or into the sea was abandoned, the coke being used for water gas production, and the tar sold for road-making. In short there was the necessary impetus to make gas cheaply; and the amount of fixed capital invested per 1000 c.ft. of gas made dropped from £1 os. 2d. in 1921 to 16s. 5d. in 1925. And with regard to the personnel of the industry, the Gas Industry Law, which came into force in October, 1925, established a regulation that an engineer in charge of a gas-works must qualify himself by passing a Government examination. In the words of Sakura Okamoto, we can "safely conclude that the business has now recovered, and is in the prime of its development."

A Question of Terms.

A FEW years ago scientific authors wrote glibly and unashamed about waste heat. Then came the shadow of doubt, and the word waste was incomplete without inverted commas. Bold inspiration resulted in the term surplus heat; but it now appears that even this requires qualification. Certainly we gain this impression on reading the contribution of Sir Arthur Duckham, K.C.B., to the proceedings of the World Power Conference. In no way desirous of sating the appetites of our readers by constantly serving up the same dish, we must refer once again, however, to the use of coke oven gas for town purposes. In the "JOURNAL" for Sept. 26 we suggested that, if reconstruction work is to take place in the coke oven industry, then the nation will reap the greatest economic advantage if the coke ovens are adjacent to the steel works. Sir Arthur Duckham, in his paper entitled "A Fuel Policy"—an extended extract of this will be published next week—having drawn attention to the fact that the general practice in America and Germany is to combine coke ovens with iron and steel works, remarks that, if sufficient ovens are installed near the iron and steel works to provide the full quantity of coke needed in the blast furnaces, these ovens will produce an ideal fuel in the form of gas for the steel furnaces, but there will be a surplus of gaseous fuel available in the plant as a whole. And in his opinion the best economy would accrue from the erection at the blast furnaces of coke ovens of such a size that the gas produced, together with the blast furnace gas, will provide all the heating requirements of the joint operations. The remaining coke needed for the blast furnaces should then be purchased from outside sources.

The foregoing is extremely interesting, and it points to the great need for having within the ranks of the fuel industries men who can appreciate what is meant by "waste" or "surplus" heat—in other words, men educated to think at all times thermally. The training of fuel technologists was dealt with by Prof. J. W. Cobb in a Conference paper which will be found in later columns; and his observations serve as an excellent amplification of Sir Arthur Duckham's plea that encouragement should be given to promising young men to take up fuel work in the universities. It will be found, he said, that such men will readily earn the good salaries they should properly be paid, by the great savings they can make. The question naturally arises, Are all gas undertakings anxious to employ capable men? Judging from the salaries which are offered in some places to those who have spent the best years of their lives in an endeavour to think thermally, the anxiety is confined to public utterance. But the fact remains that, if the undertakings are not in sufficiently prosperous a condition to-day to afford reasonable remuneration, it will very soon find that thought on such mundane affairs will be useless, for they will have been supplanted by those industries which can afford to recruit the best brains. As we have entitled this article, it is a question of terms.

Highway Problems.

We wish to direct special attention to the contribution headed "The Gas Industry and Highway Problems" in this issue of the "JOURNAL." It is by way of introduction to a series of articles from the pen of Mr. R. W. Edwards, Chairman and Managing Director of the Aldershot Gas, Water, and District Lighting Company; and the tripartite nature of his undertaking, in addition to his other well-known qualifications, make specially welcome his views on a most important matter. The reconstruction of roads in ferro-concrete has been causing Mr. Edwards "untold anxiety and trouble;" and he intends to point the urgent necessity for a favourable amendment in the existing legislation on the question.

Coke Oven Plants on Gas-Works.

It will be noted from the report of the luncheon to the World Power Fuel Conference delegates, which was given by the Governor and Directors of the Gas Light and Coke Company, that the question of the utilization of coke ovens in connection with the gas industry is likely to receive further consideration at the hands of that progressive undertaking. Sir David Milne-Watson announced that the Company were at that moment proposing to invite tenders for a very large installation of coke ovens—one, indeed, which would probably add to their carbonizing capacity something like 1200 tons of coal per day. What the ultimate decision of the Board in this matter may be, will be learned in good time; but as the Company are wishful to explore for themselves this subject of linking-up coke ovens with town gas supply, the likelihood of their taking an early opportunity of doing so is evident. No one who follows with any closeness the policy of the Gas Light and Coke Company can doubt the justice of the Governor's claim that the Company are doing the best they can to carry on in the light of modern developments.

Progress.

On later pages will be found an account of the continued progress of the Portsmouth Gas Company, whose recent history provides a first-rate example of what may be accomplished by the joint efforts of a highly efficient Board and staff, both technical and commercial. The gas output curve of the undertaking is eloquent, showing, as it does, an average annual increase of approximately 100 million c.ft. since the end of 1921, during which year normal operations were seriously interfered with by the great coal strike. In 1921 the Company's output of gas was near the 2000 million mark; and this year it is expected to approach 2750 millions. It is noteworthy that the graph before us is practically a straight line from 1925—the coal and general strikes of 1926 were taken in the Company's stride, and what was then gained has been held and consolidated.

7d. a Therm.

Much money has been spent by the Portsmouth Company of recent years. Their works have been extended very largely; liberal allowances have been made towards the development of the commercial side; their reorganized shops are a model; and no expense has been spared in catering for the welfare of their employees. Yet they have made successive reductions in the price of gas, which now stands at the gratifying level of 7d. a therm to ordinary consumers, with only a penny differential for prepayment meters. This is the most telling evidence of efficiency, and we look forward to recording their future peaks of achievement. That no lack of faith interferes with their progress is proved by the Company's recent acquisition of a further 15 acres of land adjoining the Hilsea Works.

Gas in the Kitchen.

To see ourselves as others see us is an advantage which it is not always possible to enjoy. Sometimes, however, opportunities do occur, and one is before us now, in the form of a review, in the pages of the "Ironmonger," of fuels in competition. The opinions of ironmongers are important to the gas industry; and what may be reasonably assumed to be to an extent the official view is set out temperately by our contemporary. It is by no means discomforting to the gas industry and to the gas apparatus manufacturers. Solid fuel ranges for the kitchen have been improved out of knowledge—largely, it is admitted, because of the competition of makers of gas and electrical heating appliances. The higher cost of gas for heating large supplies of water has led the solid fuel stove makers to carry the war into the competitors' country by designing stoves vertically arranged to give cooking accommodation as well as adequate hot water supplies; but as to this our con-

temporary has to say: "Complete success has not been universally achieved; something like failure has sometimes been recorded." Evidently the writer does not think the gas cooker is seriously challenged there. It may be agreed that solid fuel for heating large volumes of water is likely to remain long in prime favour; but even for this purpose there are many situations in which gas is preferred. Modern conditions in business premises and dwellings do not always favour the storage of substantial quantities of solid fuel. The "Ironmonger" itself admits that "there is no doubt the gas undertakings have a firm grip on the problem, and that water heating by gas will grow more and more in favour."

The Tragedy of Electricity.

Electricity rightly receives its due share of attention at the hands of the "Ironmonger;" but its day is still in the future. For the present, we are told, "the story of electricity in heating is one of mingled triumph and tragedy. Triumph, because of the amazing increase in efficiency, safety, and certainty of the electric stove, range, or heater; tragedy, because for so many people the cost of electricity remains utterly prohibitive. While such anomalies remain as consumers in one area paying for their current many times as much as is paid in another area but a few miles distant, there can be no satisfactory stabilization of the trade. London alone, with its appalling confusion of voltages and other ratings, remains as a gross barrier to electrical progress. Little snippings and parings of the price of electrical energy in odd boroughs are futile scrabblings over the problem, albeit they do make a readable paragraph here and there in the Daily Press." The fact that the gas and electricity undertakings all over the country are opening showrooms to which their customers are attracted is adduced as an argument for the establishment by the ironmonger of a workshop department. "Properly supervised," this "could even challenge the gas company with its free or very cheap rates for fixing its own stoves." The writer goes on to urge that such a department, which must include competent electricians, "is not only advisable, but even imperative, unless the ironmonger is to lose the new electrical trade, as, unfortunately, he lost the gas stove trade." So far as the gas industry is concerned, this is the revival of an old story. The installing of electrical apparatus would appear to be at any rate a not less complicated business.

The Standardized Page Size Proposal.

Allusion was made a week ago to a suggestion put forward by Mr. W. McWilliam, in a letter to the "Electrician," to the effect that technical journals representing similar interests could benefit themselves very largely by standardizing their page sizes. He said that a recent research conducted by the Incorporated Society of British Advertisers on the net printed size of various technical journals has revealed a bewildering variety of spaces and proportions among them. A table has been prepared giving the length and breadth of the printed area in 56 representative trade journals, together with a third column showing the relationship between the two. Perusal of this list shows that, apart from the difference in the actual size of the pages themselves, there is, from the advertisers' point of view, a more serious variation in the proportions of length and breadth. The importance of a standardized page size in technical journals, or, at any rate, of a standard shape of page, lies in the fact that a single artist's drawing could be used without modification for the supply of all necessary blocks for illustrations. This means a lot to a firm advertising in (say) a dozen journals every week. Many others have since joined in the correspondence; and it is noteworthy that all take the same view—that advertisers would hail uniformity in this respect, mainly because of the heavy cost they at present have to incur in the preparation of blocks of various sizes, to suit pages of differing dimensions. Possibly the question will be formally broached in some way. Meanwhile, so far as we have considered it, our preference is for individuality; but this could doubtless be maintained while yet doing something to standardize the relationship between length and breadth.

PERSONAL.

Mr. Bernard F. Browne (son of the late Augustus F. Browne, of the South Metropolitan Gas Company, and brother to Mr. P. E. Browne, of the Brighton and Hove General Gas Company), who is Engineer and General Manager to the City of Santos Improvements Company, is in London on a short visit. He has recently received from the Portuguese Government the distinction of the Order of Commenda du Christo, in recognition of his services to the Portuguese nationals. Included in his multifarious duties is that of management of the Tramways Transport Department, and in connection with this he is obtaining information with reference to the working of the London General Omnibus Company.

Mr. Gardner Pennington has entered into a five years' agreement with the South African Lighting Association, Ltd., and sailed for South Africa on Sept. 29, to take up his appointment as Engineer and Manager to the Association at Port Elizabeth. Mr. Pennington was articled, and also an Assistant, to the late Mr. W. R. Wilson, at Kendal, from 1910 to September, 1914. From 1914 to 1917 he was on war service, in the course of which he was severely wounded. From 1917 to 1921 Mr. Pennington acted as Assistant Manager and Chemist to the St. Albans Gas Company, and from 1921 to 1925 as Works Superintendent at the Rochester Works of the Rochester, Chatham, and Gillingham Gas Company, during which time extensive additions and alterations were made to the works. From 1925 up to the time of his present appointment, he was Engineer and Manager of the Sittingbourne District Gas Company, and during this period also various improvements were made at Sittingbourne, including the installation of a Humphreys & Glasgow water gas set, a new boiler house and boiler, boosting plant, new showrooms, and the re-sheeting of a 3-lift holder.

Mr. John James Withers, C.B.E., M.P., has been elected a Director of the Bournemouth Gas and Water Company, in place of the late Sir Charles James Jessel, Bart.

Mr. H. King Hiller was at a recent meeting of the Directors of the Biggleswade and District Gas Company unanimously elected Chairman, in succession to the late Mr. F. A. Maythorn.

Mr. H. Talbot has relinquished his position as General Manager of The Welsbach Light Company, Ltd., in order to assume the duties of General Manager of the Non-Inflammable Film Company, Ltd.

Consequent on recent retirements on superannuation, the following promotions have been made in the Bradford Corporation Gas Department: Mr. Edward Gillett (Past-President of the Yorkshire Junior Gas Association), from Works Superintendent at Thornton Board to Works Superintendent at the Birkshall Gas-Works; and Mr. Sydney West, Works Assistant at Birkshall, to be Works Superintendent at the Thornton Board Works.

Mr. William Harker, who has been Superintendent of the Bradford Gas Meter Department for fifteen years, was presented with a clock last week. Mr. Harker has been connected with the Bradford Corporation Gas Department for 45 years, and is retiring on account of ill-health. The presentation was made by Mr. E. J. Sutcliffe, the City Gas Engineer. Mrs. Harker was presented with a handbag.

It is a matter of sincere regret to a large circle of friends—made during a long period of faithful service to the industry—that failing health compels Mr. Charles Pike to give up travelling, as he has been doing, on behalf of Messrs. Willey & Co., Ltd., of Exeter. All who have been associated with Mr. Pike either in business or socially, will wish him, as we do, many years in which to enjoy his retirement. His successor is Mr. Sidney G. Glanfield.

We regret to learn that Mr. William D. Helps, late of Leeds, who some few years ago retired to Bishop's Teignton, South Devon, underwent an operation on Tuesday of last week. His friends will be pleased to hear that he is making good recovery and hopes to be back at Bishop's Teignton in a week or two.

Mr. Jim Tallentire, B.Sc., A.M.I.Mech.E., who has been appointed Assistant Engineer, Class A, Crown Colonies Lagos and Algeria, is the eldest surviving son of Mr. Wilfred Tallentire, the Gas Manager at Lurgan.

Councillor Stephen L. Pettitt, who has accepted the Mayoralty of Buxton for the coming year, is a prominent member of the Committee controlling the municipal gas undertaking, on which he has rendered valuable service for many years.

OBITUARY.

STANISLAUS MEUNIER.

It was with deep regret that we learned of the death, which occurred on Saturday last, in his 73rd year, of Mr. Stanislaus Meunier, who for 37 years had been Engineer and Manager of the Stockport Gas-Works, and had for the whole of this period been a prominent figure in the gas profession of the Manchester District. He was, indeed, well known in an even wider circle; and everywhere his genial disposition ensured for him a cordial welcome. By his death we, and many others, have lost a friend.

Mr. Meunier commenced his career as a gas engineer in 1873, entering the service of the Birmingham Gas Light Company in the drawing office. He gradually pushed ahead as draughtsman and clerk of works, and then became general assistant to Mr. Alfred Colson. When Mr. Colson was appointed Engineer of the Leicester gas undertaking, in 1882, Mr. Meunier was made Superintendent of the Adderley Street Works, which position he held until March, 1891, when he went to Stockport, upon the resignation of Mr. Jacques, who had been there for many years.

He was a man devoted to his work, and possessing high technical qualifications; and the success which has attended the Stockport gas undertaking during the period that he has been in charge has been due in no small measure to his ability and initiative. When he succeeded the late Mr. Jacques in 1891, the Gas Department had three works—one at Heaton Lane and one at Millgate, besides the main works at Portwood. In those days Mr. Meunier had also charge of the Electricity Department of the Corporation, and filled this dual rôle until the appointment of an electrical engineer in 1903. Mr. Meunier was responsible for the reconstruction scheme which has been carried out at the Portwood Gas-Works during the post-war period. The first installation of vertical retorts was put into operation in 1921; and these proving satisfactory, a further order was placed with the Woodall-Duckham Company for an installation which was completed in 1926.

Mr. Meunier was a Past Master of the Northern Star Lodge and a Past President of the Manchester District Institution of Gas Engineers. He was married twice, and leaves a widow, four sons, and two daughters, to whom sympathy in their bereavement is extended.

His many friends in the gas industry will join with us in expressing their sincere sympathy with Mr. William A. Surridge (formerly Director of Messrs. E. Foster & Co., and now on the Board of the Tottenham District Light, Heat, and Power Company, and of other Gas Companies) in the serious loss he has sustained by the death of his wife, which occurred somewhat suddenly at their residence in West Norwood, on Monday, Oct. 1. Mrs. Surridge was present with her husband at the opening assembly of the World Power Conference on the previous Monday afternoon, when she appeared to be in her normal health, though not well. Arrangements had been made for a course of treatment at Buxton, but shortly before the time for departure, on Sept. 28, she was taken seriously ill, gradually growing weaker until the end came. The last solemn rites were observed at Brookwood Crematorium on Friday last. It will be recalled that Mr. and Mrs. Surridge celebrated their golden wedding on Oct. 18, 1927, when a party of relatives and intimate friends assembled at a luncheon given in honour of the occasion.

It is with deep regret we have to announce the sudden death of Mr. G. F. CHURCH, of Messrs. Bale & Church, Ltd., on Friday, Oct. 5. His connection with the gas industry extended over 33 years.

THE GAS INDUSTRY AND HIGHWAY PROBLEMS.

By R. W. EDWARDS, Chairman and Managing Director of the Aldershot Gas, Water, and District Lighting Company.

INTRODUCTORY.

> "That rapid increase in the volume and weight of traffic by road had profoundly affected the methods and standards applicable to the maintenance and construction of roads and bridges."

These words were used by the Minister of Transport, speaking at Luton on Oct. 2, and I couple with them the passage in the Editorial article in your issue of July 18 last—

> "We should not mind that, provided it was a basis which recognized the need of every public service and the requirement of accommodation for the distribution of necessaries and commodities."

Surrounding, and intervening in, these statements will be my arguments that the time is approaching when the whole question of the laying of mains and cables in highways should be thoroughly investigated, and remedial legislation, adequate to cope with the recent developments, pressed for.

Since the commencement of this year I have been engaged in urging, so far as in me lay, the points with which I am about to deal. Now, more than ever, do I wish, if possible, to call the attention of the gas industry to this problem, for I feel that occurrences of the last few months indicate that an opportunity has arisen for the industry to obtain a settlement of the whole question—an opportunity which may not present itself so favourably again.

You may ask what grounds I have for taking upon myself this task. To this question I can make at least three answers: The first is, that I shoulder this task in the apparent absence of someone worthier; and it is in the now approaching active days that we must strike. It will be admitted, after I have put my case, that time is of the essence of the matter—very much so. The second reason is that my experience of highway problems, and the incapacity of present-day legislation to cope with them, has been of so bitter a nature for some time past that, like Robert Clive, "I stand astounded at my own moderation." The third reply is that I can claim some degree of qualification, in that I represent a three-sided undertaking—gas, water, and electricity.

With these, then, as my primary reasons for obtruding my views upon you, I now propose to deal with the whole question in a series of articles, of which the first will treat of the local situation in regard to the matter, since it was the local situation with which I have had to grapple in one of our numerous districts, astride of three counties, which first brought me to realize the urgent necessity for a favourable amendment in the existing legislation on the question at issue. You will concede that any position of affairs is better understood by the appreciation of the events leading up to it. Thus, my personal attitude towards highway problems can only be understood in the light of certain cases in the reconstruction of roads in ferro-concrete, which have occasioned me untold anxiety and trouble, and would appear likely to cause me even more in the future.

FORTHCOMING ENGAGEMENTS.

[Secretaries of Gas and Kindred Organizations are asked to assist in making this diary of events as complete and useful as possible by sending the earliest intimation of all meetings.]

Oct. 11.—MIDLAND JUNIOR GAS ASSOCIATION.—Meeting in the Council House, Birmingham. Presidential address of Mr. F. Caudwell, of Shrewsbury.

Oct. 16.—SOUTHERN ASSOCIATION OF GAS ENGINEERS AND MANAGERS (EASTERN DISTRICT).—Meeting at 28, Grosvenor Gardens, S.W. 1, at 2.30.

Oct. 17.—MANCHESTER DISTRICT INSTITUTION OF GAS ENGINEERS.—Meeting in Manchester. Visit to the works of Messrs. R. & J. Dempster, Ltd. Paper by Mr. William Buckley on "The Maintenance Costs of Vertical Retorts."

Oct. 18.—EASTERN COUNTIES GAS MANAGERS' ASSOCIATION.—Autumn meeting in London.

Oct. 20.—SCOTTISH JUNIOR GAS ASSOCIATION (WESTERN DISTRICT).—Visit to the Kingshill Colliery of the Coltness Iron Company, Ltd.

Oct. 22-24.—BRITISH COMMERCIAL GAS ASSOCIATION.—Annual Conference at York.

Nov. 3.—MIDLAND JUNIOR GAS ASSOCIATION.—Visit to the Shrewsbury Gas-Works.

Nov. 14.—SOUTHERN ASSOCIATION OF GAS ENGINEERS AND MANAGERS.—General meeting at the Hotel Cecil, Strand, W.C. 2, at 2.15 p.m.

Nov. 22.—SOCIETY OF BRITISH GAS INDUSTRIES.—Autumn general meeting. Hotel Cecil.

ON THE ELECTRICAL SIDE.

Generation of Electricity in Great Britain.

As a Government report, there have been issued the analyses and summaries of the returns made to the Electricity Commissioners of units generated and fuel consumed at generating stations in Great Britain during the year ended March 31, 1928. Summary tables showing the best results as regards average consumption of fuel and thermal efficiency are again included. As in previous issues, "composite" stations containing more than one type of prime mover—*e.g.*, steam plant and oil engines—have been classified in accordance with the type of plant by which the major portion of the output was generated. Similarly, in arriving at the average consumption of fuel per unit generated in the case of stations where more than one class of fuel—*e.g.*, coal and oil—was consumed, the actual fuel consumption at each such station has been converted (on the basis of average calorific values) into an equivalent tonnage of the class of fuel from which the largest output was obtained. Returns were received in respect of 570 generating stations—the same total as in the previous year. The total number of units generated at the stations during 1927-28 was 9,927,850,630, an increase of 18·7 p.ct. on the figures for the previous year; and the total coal, coke, and fuel oil consumed was 9,224,151 tons, or an increase of 4·1 p.ct. It is pointed out, however, that in seeking to draw comparisons with the previous year regard must be had to the adverse effect of the prolonged coal strike in 1926-27 upon the output and operating results in that year.

Fuel Consumption and Thermal Efficiency.

It is gathered from the table of group stations with lowest fuel consumption per unit generated, that of the oil engine stations the Bognor Gas Light and Coke Company are lowest, with 0·62 lb. of fuel per unit generated; of the steam stations, Padiham (Lancashire Electric Power Company) is lowest, with 1·37 lbs.; and of the gas producer stations, Thirsk (Newcastle-upon-Tyne Electric Supply Company, Ltd., and Associated Companies) is lowest, with 1·45 lbs. (converted). It should be pointed out that Thirsk represents a composite station, containing more than one type of prime mover; and the classification is in accordance with the type of plant by which the major portion of the output was generated. In the table of group stations with highest thermal efficiency, among the steam stations Barton (Manchester Corporation) heads the list with 21·07 p.ct. thermal efficiency (approximate); for the oil engine stations, the Buxton Corporation is highest, with 28·59 p.ct.; and of the gas producer stations, the Guernsey Electric Light and Power Company, Ltd. (which is a composite station), comes first, with 18·55 p.ct. Of the steam stations, the average fuel consumption per unit generated was 2·16 lbs. of coal, as compared with 2·43 lbs. for the year ended March 31, 1927; of the oil engine stations (converted to basis of coal), 0·91 lb., as compared with 1·10 lbs.; and of the gas producer stations (converted to basis of coal), 2·24 lbs., as compared with 2·47 lbs. There were 23 stations generating electricity by means of engines using town gas, as compared with 25 in the previous year.

Post Office Lines and Overhead Transmission.

We were not exactly staggered to read at the head of a letter appearing in "The Times" a week or so ago, "No Electric Light at Harefield." It seems that there might be more important matters calling for the attention of the great body of influential readers of that paper, even though, "as regards lighting, Harefield is still in the Dark Ages." Harefield, however, is in the interesting position of having a grievance; and the writer of the letter in question voices that grievance. At the same time, he adopts a larger view than the purely local one of Harefield; for he asks whether it is advancing the scheme for the general electrification of England to by-pass such a large group of dwellings on the very outskirts of London. Electricians will hope that the omission to supply Harefield may not seriously jeopardize "the scheme for the general electrification of England;" but they will note the reason for "crying-off" given by the company who had at one time contemplated bringing their cables into the area. The company state that they "have looked further into the question of the possibility of erecting overhead transmission lines through the village, and find that, owing to the existing Post Office lines, it will be impracticable." The condition of affairs which is depriving Harefield of the inestimable benefit of electric light—the correspondent says nothing of the ubiquitous vacuum cleaner, and the numerous other blessings that a supply of current would shower upon the village—will doubtless operate equally in many other places. It is to be hoped that the gas industry will not be blamed for raising this further objection to overhead transmission lines.

Disappointment at Haworth.

"We cannot go on indefinitely bearing a rate of 1s. in the pound on the rates for electricity," declared the chairman, when addressing the members of the Haworth Urban District Council. It is a heavy price to pay for having provided "the most modern means of light and power production;" and one can quite understand the chairman's suggestion that it might be advisable to consider the leasing of the electric lighting order to some outside body for a period of years. While firmly convinced that electricity is the light of the future, one of the members had to admit that for the time being they are at a standstill in Haworth. Clearly the inhabitants do not regard it as the light of the present; and it is to be feared that their faith in the future has been sadly shaken. People are not choosing electricity against gas; and a strong feeling has been aroused in the district because of the fact that people who are not using electricity are compelled to pay a shilling rate towards the cost of it. The sad case of Haworth is not cited with any feeling of triumph, but merely as a reminder to the gas industry of the wide difference that sometimes is found between promise and fulfilment.

Who Started the "Farthing Electricity" Hare?

We are tempted to ask this question in view of the unlooked-for result of the Newspaper Press "stunt" of a fortnight or so ago, to which attention was drawn in the editorial columns at the time. We then ventured the opinion that the organizers of the World Power Fuel Conference and Mr. R. P. Sloan, C.B.E., were not a little surprised at the widespread publicity accorded by a large section of the Daily Press to the paper which Mr. Sloan had prepared for the conference. Certainly it surprised us, and on the first blush it seemed to us that some good propaganda work had been accomplished. But this was only the first impression. When the subject came before the conference, Mr. Sloan himself took the opportunity of repudiating, as the "Electrical Review" says, "the grossly exaggerated statements which had appeared in the Daily Press." In his paper, Mr. Sloan stated that under present conditions it was not likely that any large direct economies might result from the system he described; and he added that no important commercial economies had so far been obtained. "Nevertheless," our contemporary remarks, "with these words before them some of the daily papers thought fit to create a sensation with the promise of 'electricity at a farthing a unit,' and one went so far as to allege that the Electricity Commissioners believed that 'farthing-a-unit electricity' was 'well within the scope of schemes now being evolved by the Commissioners.'" Obviously some electricians, at any rate, realize the serious consequences that may accrue from over-statement. So who was it that started this electric hare? Could it by any chance have been those "gas interests," which are blamed for so much?

And When Will it be Overtaken?

The Kent coalfield has been the scene of so many bitter disappointments in the past that no one will have it in his heart to begrudge any good fortune that may come along in the future. In spite of all that has happened, we ourselves have never lost faith in a useful industrial life for that part of the country; but here again much harm has been done by exaggerating possibilities and belittling obstacles in the way. Now once more we see a "Wonderful Future Predicted," and we hope there is not more disappointment in store. At a meeting of the Tilmanstone Colliery people, Mr. Tilden Smith (who has developed the colliery) spoke of a programme of £2,000,000 expenditure. The proposal is to establish one of the biggest cement works in the world; and the organization he is setting-up will, Mr. Tilden Smith declared, enable him to supply the whole of London with electricity at an even lower price than a farthing a unit. Mr. Tilden Smith referred to Newcastle as generating and selling electricity in bulk at a farthing a unit, and probably it is a bulk supply on which he himself was basing his calculations. This is of course a very different thing from the statements in the Daily Press, to which such great exception has been taken; and on the whole it does not appear as though Mr. Tilden Smith is on the way to overtake the "Farthing Electricity" Hare as depicted in our popular papers.

A Large Order for Gas-Operated Refrigerators.

We learn with gratification that Messrs. J. Lyons & Co. have placed an initial order for 500 gas-operated "Electrolux" ice-cream conservators. These are to be installed by March, 1929. The figure is a startling one for a single order, but much more is implied in this development of gas refrigeration than would at first appear. Messrs. Lyons, of course, conserve large quantities of ice-cream, which they distribute not only through their own branches, but through outside caterers who act as their agents. It is in the premises of these agent firms that the newly ordered ice-cream conservators will be installed. Readers probably are aware that Messrs. Lyons themselves use as much gas as a town of 100,000 people; but it does not always happen that the caterer who desires refrigeration is already a consumer of gas on a comparable scale. Circumstances must even now often exist in which the caterer does not realize the full possibilities of gas service, and often a new appeal to his interest in gas will open the way to further sales. Gas refrigeration is likely to play an important part in consolidating—often in securing—his favour.

NORTH OF ENGLAND GAS MANAGERS' ASSOCIATION.

The Autumn Meeting of the North of England Gas Managers' Association was held in the King's Hall, South Shields, on Oct. 5. Mr. Dugald Currie, the President, occupied the chair.

Losses by Death.

The President, before proceeding with the business of the meeting, referred to the loss the Association had sustained through the deaths of Mr. W. E. Walton, of Bishop Auckland; Mr. S. Shadbolt, of South Bank; and Mr. J. E. Williams, of Manchester. Mr. Walton, he said, was elected a member in 1886, and had been connected with the industry for half-a-century. He took a deep interest in the affairs of the Association, particularly in connection with the General Purposes Section. Mr. Shadbolt came from Fleetwood thirteen years ago, and joined the Association in 1916. He was a most enthusiastic gas engineer, and was a member of the National Gas Council and the Federation of Gas Employers, to which organizations he rendered valuable service. During the year 1924-25, he occupied the Presidential Chair of the Association. Mr. Williams had been connected with the gas industry for about sixty years, and had been an associate member since 1901. The President, on behalf of the members, expressed the great sense of loss they felt as an Association. He also referred to the death of Mr. Arthur F. Bezant, Editor of the "Gas Journal," who, he said, was a tower of strength to the industry. His loss would be felt in many quarters.

A vote of sympathy was passed in silence.

Mr. Norman S. Cox, the Hon. Secretary, announced apologies for absence, and read a letter from Mr. J. Terrace, who stated that he hoped to be able to visit the Association during his term of office as President of The Institution of Gas Engineers. Mr. Cox added that he had written expressing that the members greatly regretted his inability to attend the present meeting, and intimating that the next meeting of the Association would probably be held in Newcastle on May 3. Mr. Terrace had promised to attend that meeting.

New Members.

New members were elected as follows:

Members.—Mr. John William Mills, of Wooler; and Mr. John Richard Porter, of South Shields.

Transferred to Full Membership.—Mr. Henry Townsley, of South Shields; and Mr. John W. Pallister, of Middlesbrough.

Associate Members.—Messrs. William A. Briggs, of Newcastle; Leslie B. Chapman, of Newcastle; William H. Cunningham, of Newcastle; Harold B. Kendrick, of Carlisle; and William O. Kirkwood, of Sunderland.

Presidential Address.

Mr. Dugald Currie then read his address, which will be found on pp. 107-12.

Vote of Thanks.

Mr. J. R. Bradshaw (Hartlepool), proposing a vote of thanks to the President for his address, observed that Mr. Currie had tackled something concrete and definite, instead of wandering through the whole gamut of the industry. Presidential addresses were often spoiled by trying to cover too much ground. The President's pressure difficulties particularly interested him. With regard to the spraying plant, the one objection was that they did not know how far away the liquid would come down. He congratulated Mr. Currie on his test figures for water gas, and described the arrangement of the tar towers as ingenious.

Mr. G. E. Anderson (Newcastle) seconding the vote, said that it was fairly well known that Mr. Currie could claim the distinction of having given more than one presidential address. He believed this was the third. The address was of practical interest to them whether they were concerned with the manufacture or with the distribution of gas.

The President thanked the meeting for the cordial manner in which they had received his address. He also expressed pleasure at seeing a very old member of the Association among them—Mr. Charles Wood, formerly Engineer and Manager to the Bradford Gas Department.

Mr. Wood, returning thanks, said that he was as pleased to come back among them as they were to see him. He took a warm interest in South Shields.

THE PRESIDENT,

Mr. Dugald Currie, of South Shields.

Mr. Currie was educated at the Campbeltown Grammar School, Argyllshire, in which town his late father occupied the position of Engineer and Manager of the Corporation Gas Undertaking. After leaving school he spent four years in the Town Chamberlain's Office in his native town, receiving a business training, after which he served a full engineering apprenticeship with Messrs. Hanna, Donald, and Wilson, of Paisley. His first official appointment in the gas industry was at Stirling, where he held the position of Assistant Engineer and Manager. His later appointments include Engineering Assistant at the Belfast Gas-Works, Engineer and Manager at Airdrie, and Engineer and General Manager at Nelson. In the early part of 1919 he was appointed to his present position of Engineer and General Manager to the South Shields Gas Company. In 1909-10 he was President of the Scottish Junior Gas Association (Western District), and in 1915 he occupied the Presidential Chair at the Spring Meeting of Scottish Gas Managers.

After the meeting, the members visited the South Shields Gas-Works, where they were escorted over the plant by Mr. J. O. Ingham, the Assistant Engineer, and Mr. R. Porter, the Works Manager.

AMERICAN GAS ASSOCIATION'S NEW TESTING LABORATORY.

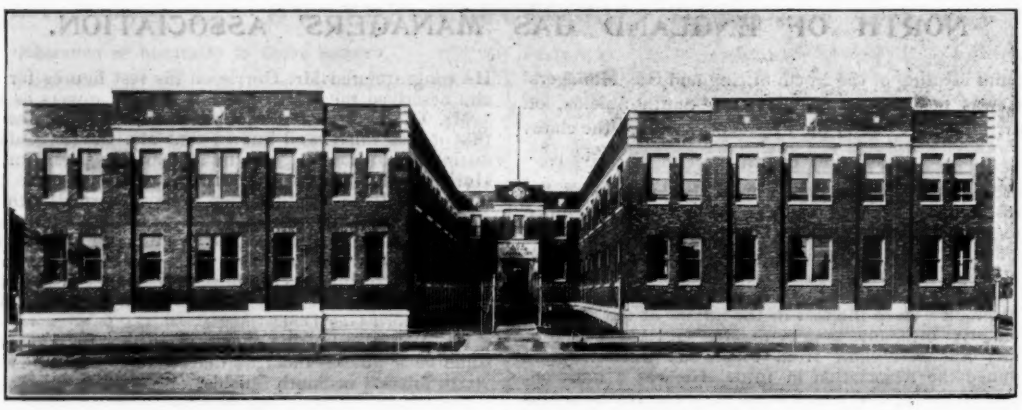
Dedication Ceremony.

The new Testing Laboratory of the American Gas Association at Cleveland, Ohio, was officially dedicated on Sept. 13, when Mr. Oscar H. Fogg, President of the Association, unveiled a tablet which states that the building "is dedicated to promote and develop the gas industry to the end that it may serve to the fullest possible extent the best interests of the public."

Messrs. J. G. Clark, of the Gas Light and Coke Company; R. W. Gallagher, President of the East Ohio Gas Company, Cleveland; and Carl Shuler, Director of Law for the City of Cleveland, were the speakers at a luncheon, attended by more than a hundred gas executives and officials, held immediately after the unveiling ceremonies.

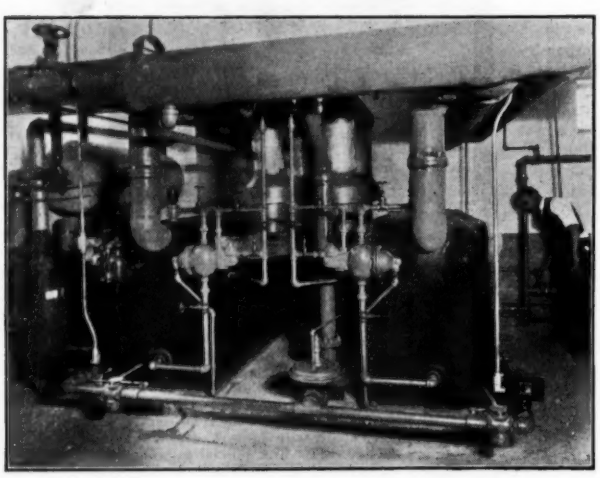
Mr. Fogg, in unveiling the tablet, said that the laboratory was in no sense a commercial enterprise. It was the tangible expression of the industry's allegiance to the principle that its greatest progress would be made through providing the best possible service to the American people. This structure, with its equipment, was initiated, erected, paid for, and sponsored by the organized gas industry of North America, made up of gas companies, manufacturer companies, and individuals.

At the luncheon, Mr. Gallagher, who is Chairman of the Laboratory Managing Committee, reviewed the history of the laboratory. He observed that, though a few who conceived the idea of a laboratory building had some conception of the possibilities that the laboratory held for the gas industry as a whole, he was doubtful whether two years ago any of them anticipated such possibilities as they had to-day. The staff had done wonderful work with limited facilities. That they functioned as well as they did, and that they gave results which were uniformly good, had brought about the possibilities of this larger and more efficient laboratory. He could not say too much of Mr. R. M. Conner, the Laboratory Director, and his staff of assistants. Mr. Gallagher also gave some interesting figures about the Testing Laboratory. He said that since the laboratory was started 2½ years ago, 258 water heaters, 281 furnaces and boilers, 838 space heaters, and 9500 stoves and ranges—a total of some 11,000 gas appliances—had been approved. Laboratory inspectors had travelled 25,000 miles. On 98 p.ct. of the appliances which had come to the laboratory for inspection and tests, there had been some suggestions made which had benefited the appliances, and, of



necessity, the manufacturers and the gas-consuming public. The mixed gas research work being conducted at the laboratory was well under way, and some 30,000 tests had already been made.

Col. Fogg, President of the Association, gave a brief address, and then called upon a member of the Association's Executive Board to move that a tablet be prepared to include the names of the Managing Committee of the Laboratory. This motion was passed.

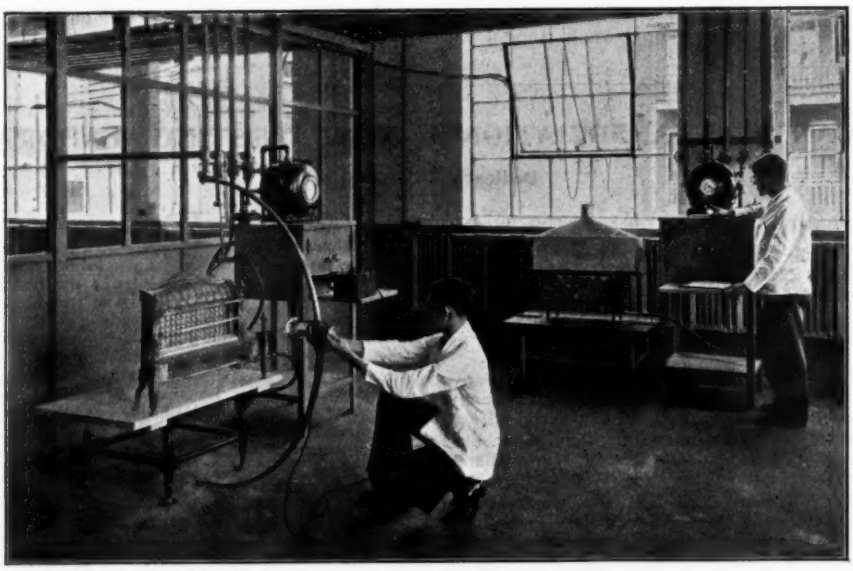


Gas Heating Plant in the New Laboratory, showing the Water Heater on the left, and the two Steam Boilers in the centre.

Mr. Carl Shuler then made a stirring speech in which he complimented the gas industry on the beautiful and efficient building it had erected. He said that utilities of to-day were far different from those of twenty or more years ago. Now the utilities were attempting to work with their customers to give them a better service at a cheaper price. The laboratory was indicative of that spirit in the gas industry.

Mr. J. G. Clark was the concluding speaker at the luncheon. After paying the respects of the British gas industry, he said that he considered himself very fortunate in being in that part of the world when this important event was taking place. It was not originally planned so; but when he left England a few weeks ago, almost the very last words that the Governor of the Gas Light and Coke Company, Sir David Milne-Watson, said to him were: "While you are in America, I want you to ask permission to visit the new laboratory of the American Gas Association in Cleveland." At that time it was not known to him (Mr. Clark) that the official dedication was to take place at this time, and he was sure that had the President of The Institution of Gas Engineers known that he (the speaker) would be present, he would have entrusted him with the best wishes of the Institution in the new sphere of endeavour which you the "A.G.A." were initiating that day. Mr. Clark observed that he was attached to a large gas undertaking in London, under the administration of Sir David Milne-Watson, who had in hundreds of ways shown his interest in the scientific methods of the gas industry—which was, of course, the backbone of the work of the American Gas Association in their new endeavour. Further he (the speaker) happened to be attached to the Gas Light and Coke Company in a capacity which included work which was on almost parallel lines to that which they were undertaking in Cleveland. He was greatly pleased when he read the words on the bronze tablet unveiled by President Fogg, that this Institution was dedicated to the service of the gas industry—not only the American gas industry, but to the gas industry and the public. It was well and often said that science had no frontiers, and he always felt that the gas industry was an important branch of science, and had no frontiers. The inscription indicated that perhaps they on the other side of the water might gain useful information from the Association; and he assured them that they would not fail to take advantage of it.

He had had the good fortune of inspecting the building in detail, with the kind permission of Mr. Conner, the Director; and he had been struck at once with the fact that the problems of the Association were similar to those they had to face in England. They felt that they had a very good commodity to sell—gas. It was one of the finest fuels the world had ever known, when it was used properly. It was efficient, economical, safe, and healthy, with proper use. That brought him to the whole crux of the problem—it must be utilized properly. In England the manufacturers of gas appliances did not possess sufficient information or knowledge to understand the complete gas technique of an appliance. They did their best. He was often amazed when he saw an appliance which was a perfect model of foundry work, which contained, too, all the qualities



CONDUCTING EFFICIENCY AND COMBUSTION TESTS ON GAS FIRES.

of good workmanship, and yet was lacking in many of the essentials that would make it a perfect appliance. That, of course, meant application of effort—the application of chemists and engineers.

They were familiar in England, as Americans were in their own country, with accidents of various kinds caused by gas appliances; but he always felt they were due either to incorrect manufacturing methods or incorrect adjustments. He understood that one of the great problems before the "A.G.A." Laboratory was to correct such situations, and thus help the development of the gas industry and make sure that all gas was consumed efficiently and safely. They had no central laboratory in England such as the one in Cleveland, but all the leading gas companies and the manufacturers of gas appliances had great laboratory facilities, and everything was co-ordinated in such a manner that information available at one place was readily available at another. The central organizations, such as the National Gas Council, the British Commercial Gas Association, and The Institution of Gas Engineers were the recipients of all information gathered, so that they performed in a slightly different way what they were doing in America, and they had a co-ordination of effort which was all the time tending to eliminate imperfect gas appliances and methods, and pointing the way to improvements.

Perhaps he ought to add that in England they had for some time past been working in close association with their Government Departments, so that they might have, in carrying through any efforts for the improvement of the gas industry, some authority which permitted them to do the things which could not be done without such authority. It was not possible to regard the manufacturer of an imperfect appliance as committing a criminal offence; but unless there was some authority behind their endeavours, they would not secure all the improvements which were desirable.

Concluding his remarks, Mr. Clark expressed his best wishes for the success of the work of the "A.G.A." It could do nothing but good for the gas industry in America and throughout the world. They were to be highly complimented upon the success they had already achieved; and he hoped that as the years went on, the influence of the new laboratory would increase.

The Laboratory.

The new laboratory building is a completely equipped gas appliance and research laboratory. It is heated by gas, and provides roughly 3200 sq. ft. of office space, 8700 sq. ft. of storage space, and 14,700 sq. ft. for appliance testing and research. The testing rooms are spacious, and provision has been made for expansion in future years. It is inevitable that the laboratory will assume an even more important place than it enjoys to-day; and in planning the new building, adequate allowances were made for growth. All the appliance testing equipment installed is as far as possible automatic, to eliminate the personal equation.

The American Gas Association now serve more than 200 manufacturers, and for them have provided three large rooms. These are completely equipped, and manufacturers may use them for their own work. More than two miles of pipe are installed in the building to provide gas, water, and air to the various rooms. The laboratory has the unqualified support of the entire gas industry in America, and the co-operation of the U.S. Bureaux of Mines and Standards, the Public Health Service, and other interested groups.

THE CERAMIC SOCIETY.

Meeting of the Refractory Materials Section in Glasgow.

The following are extracts from some of the papers contributed at the autumn meeting.

The Functions of Regenerators in Relation to the Refractory Materials of Construction.

By A. T. Green, F.Inst.P., A.M.I.Chem.E.

After a short introductory notice of the invention of regenerators by Siemens about seventy years ago, it is stated that regeneration now finds a wide application, particularly in the iron and steel industries, in coking practice, and in the manufacture of glass; the underlying principles being, of course, the same in all cases.

In the open-hearth steel furnace, since it is known that, within limits, the higher the temperature of working, the quicker the steel production, consequent on the increased velocity of reaction between the slag and metal, hence the more effective the utilization of the heat of the products of combustion, the greater the over-all efficiency of steel-making by the open-hearth process; the regenerators being of decisive importance to the heat economy of the process. In order to obtain satisfactory results, the flame must lick the surface of the bath, and the gas pressure in the heating chamber must be equal to atmospheric. The correct direction and condition of the flame depends upon factors which are in great measure controlled by the regenerators.

Regenerator design represents in practice a compromise between thermal, mechanical, and operational considerations. F. Clements states the factors involved in the provision of an efficient system of regeneration as follows:

(1) The shape and dimensions of the regenerative chamber should be such that the gases during regeneration and recuperation are evenly distributed over the whole of the chequerwork.

(2) The weight of suitable brickwork forming the chequering should suffice to ensure a store of heat ample for regeneration without a wide range of temperature variation.

(3) The effective heating surface presented by the chequerwork should be ample to allow for a rapid heat exchange, and the arrangement of the chequers should be such that the particles of gas are brought into intimate contact with the hot surfaces.

There is a certain velocity of flow that will result in maximum heat transfer per unit of heating surface, and in the case of properly designed heat transfer elements—whether they be regenerators, recuperators, or steam boilers—it is very probable that the natural convection currents will assume this velocity. Both higher and lower velocities will reduce the rate of heat transfer.

The design and dimensions of regenerators are discussed at some length, and important data are given in several tables.

The maximum temperature at the top of regenerators may be near 1600° C., while in the bottom zones the average temperature is about 500° C. The products of combustion pass through the bath at a temperature of about 1500° C. with velocities of 150 and 100 ft. per second for the gas and the air ports respectively. The average temperatures of the gases leaving the chequers is about 630° C. (slightly higher in the gas chequers), while the average velocity through the regenerators is 8 ft. and 13·2 ft. per second for the gas chequers and the air chequers respectively. On reversal, the incoming gas and air gain considerably in temperature and pressure. The average velocity through the chequers is 8·5 ft. per second for gas and 10 ft. for air regenerators, but at the uptakes the velocity has increased at about 85 ft. per second. On leaving the chequers the temperature of the gas and air approaches 1250° C. The gas enters the regenerators at about 700° C. with a velocity of 40 ft. per second. The air is admitted cold at the regulating valve.

According to R. J. Sarjant, the efficiency of regenerators varies between 60 and 85 p.ct., taking the sensible heat conveyed (to the preheated air and gas) as a ratio of the heat abstracted from the products of combustion. F. Clements found 58 and 82 p.ct. for this efficiency factor for the gas and the air regenerators respectively. A true thermal efficiency would be given by the ratio of the heat returned (to the gas and air) to the total sensible heat in the products of combustion reaching the chequers. This over-all thermal efficiency is about 40 p.ct. The losses from the regenerators by radiation and convection amount to about 16 p.ct. of the total heat losses of the open-hearth plant, which is excessive in view of the fact that the thermal efficiency of the open-hearth process is only about 17 p.ct. Hence the insulation of the brickwork is very important, and the insertion of an insulating wall between the outer wall of red brick and the interior lining should be sufficient to reduce these losses to a minimum. Such an insulation may also greatly facilitate the even passage of the gases through the chambers.

It is almost universal practice to use either fireclay, siliceous, or silica products as the material of construction for regenerators. Silica bricks are usually confined to the top courses, but in some cases are used throughout the chequering. Siliceous or fireclay bricks generally form the main filling.

Heat capacity per unit volume at a particular temperature is the product of the specific heat and the apparent specific gravity at that temperature. In silica and fireclay products (among other materials) the specific heat increases with temperatures. With carborundum it increases to a maximum at about 500° C., and decreases with further rise of temperature. Magnesite shows relatively high specific heat.

With regard to the thermal properties of possible regenerator fillings, it seems safe to infer that:

(1) Magnesite products appear to possess thermal advantages from the aspects of heat storage and thermal conductivity.

(2) Fireclay bricks are very efficient thermal agents, absorbing and transmitting comparatively large quantities of heat.

(3) Silica products have high values for temperature diffusivity, and give up their heat slightly more rapidly than fireclay bricks. However, silica bricks have comparatively low heat capacities, so that the heat stored and transferred to the gases is less than with fireclay or aluminous bricks. This makes them less suitable for chequer brickwork from a thermal point of view.

(4) Siliceous bricks appear to compromise the thermal properties of silica and fireclay products.

(5) According to S. M. Phelps, aluminous refractories are effective storage agents, and would form efficient regenerator bricks from a thermal standpoint.

(6) Recrystallized silicon carbide (*i.e.*, carborundum) has high thermal conductivity and low specific heat. For chequerwork it would only be valuable where rapid reversals of the regenerators are essential.

(7) Differences in regenerator efficiency can be obtained by using fireclay bricks of varying porosity. The denser the brick, the more efficient for chequerwork.

(8) S. M. Phelps states that—from experimental evidence—the glazing of bricks during industrial usage does not impair their thermal efficiency.

The influence of slags and dusts is discussed at some length, but from considerations of space cannot be taken up here. The same remark applies in some measure to structural and other features in usage.

The final topic concerns the selection of refractories. Magnesite bricks have desirable thermal properties, but are ruled out on account of cost and spalling tendency. Carborundum refractories are not good for open-hearth regenerators, from thermal, economic, and operational considerations. Highly aluminous refractories, when cost is taken into account, do not seem to be preferable to superior fireclay products. Economical considerations seem to limit the choice to silica, siliceous, and fireclay bricks. Silica products or highly siliceous products (with 90 p.ct. of silica) are best for the top courses. Siliceous and superior fireclay products serve well as regenerator fillings.

JOINTING CEMENTS.

By CYRIL EDWARDS (Research Section, The Woodall-Duckham Companies).

This paper deals only with jointing cements required for silica bricks and firebricks. All the properties desirable in such a cement cannot be obtained together in any single product, and as some can only be developed in high degree at the expense of others, the main problem is to secure the best combination possible for any particular purpose.

The chief properties to be considered are working qualities, grain size and texture, shrinkage, adherence to bricks, hardness (after drying and when fired), strength, and refractoriness.

Good working quality in a jointing cement is essential for the proper laying of the bricks. Without sufficient plasticity it is impossible to obtain either thin or well-filled joints, especially in the case of vertical joints between tongued and grooved bricks. With insufficient plasticity the cement dries so rapidly that the necessary mobility and semi-fluid condition are lost before the brick can be properly fixed. A "short" cement hardens almost as soon as it touches the brick. Cements are generally used in the wet plastic condition, but some "short" cements are used in the semi-fluid state. Damping of the denser firebricks is scarcely necessary, but the more porous silica bricks are often damped with good effects. The working qualities of cement can be improved by reduction in grain size.

With regard to grain size and texture, as it is generally accepted as desirable that joints should not be thicker than $\frac{1}{8}$ in., the cement particles should mostly pass a 40 (cement mesh) sieve, and practically none of the particles should exceed $\frac{1}{2}$ in., while a considerable proportion should easily pass a 200 (cement mesh) sieve, lest the cement may be short in working. On the whole, excessive fineness is not necessary, and grain size requirements are met if a cement passes a 20 cement mesh sieve and contains 45 to 50 p.ct. passing a 200 mesh sieve.

Concerning shrinkage, it has been found in actual practice that cements showing 0 to 2 p.ct. linear contraction on drying, and with an after-expansion of 1 to 1·5 p.ct. dry to fired, have proved successful in use.

Cements are easily obtainable which will adhere well to ordinary firebricks, whether dried or fired, but it is more difficult with silica bricks. It is found that cements containing much converted quartz (as silica brick itself) generally adhere better to silica bricks than do those composed mostly of raw ganister or quartzite. Damping of the bricks appears to improve the adherence of the cement.

Cements for use at lower temperatures are made harder superficially by addition of a soluble salt such as sodium silicate (water-glass). Glue and sulphite lye have been used for the same purpose. In many cases hardness on drying is of much less consequence than hardness after firing. To give a cement uniform hardness after firing, such a material as finely ground glass is sometimes added.

The tensile strength of cements after firing is influenced by the fineness and shape of the particles (angular or round), and by the presence of low-temperature fluxes. A good refractory cement for use at temperatures up to 1500° C. should have a cold tensile strength of at least 80 lbs. per sq. in. after firing at 1300° C. for two hours.

Refractoriness is generally reduced by finer grinding, but in cements made of silica rock bonded with lime the refractoriness may actually be increased by reducing the grain size.

The most important raw materials for jointing cements are silica rock (including sand, ganister, and quartzite), silica brick, raw fireclay, and fireclay grog. The chief bonding agents are ball clay, lime, Portland cement, sodium silicate, and ground glass. The testing of jointing cements and the effect of usage on cement are discussed.

A COMPARISON OF THE PROPERTIES AND INDUSTRIAL DURABILITY OF LIME-BONDED AND CLAY-BONDED SILICA BRICKS.

By W. J. REES, B.Sc., F.I.C., and W. HUGILL, M.Met.

This paper is a digest of the full report of the investigation which appeared as Bulletin No. 15 of the British Refractories Research Association.

Preliminary laboratory experiments were carried out with small bricks made from six different quartzites; the bonds used being ball clay and lime respectively. Details of the 57 batches are given in tabulated form.

A series of batches of 9 in. by $4\frac{1}{2}$ in. by $2\frac{1}{2}$ in. bricks was then made, using as bonds four ball clays, two china clays, a plastic fireclay, and a purified marl, with lime as before for comparisons. Data relating to these are given in tables, and results are shown by means of diagrams.

Large batches of bricks were next made under commercial conditions of manufacture for trial in industrial furnaces. These batches were made from Totley ganister, Renwyllt stone, Bwlchgwyn silica stone, and crushed quartzite pebbles (Bunter) from Bawtry.

The general conclusions arrived at were as follows:

(1) Clay-bonded silica bricks can be made by the same process of manufacture as ordinary lime-bonded bricks. Better and quicker spreading of the clay over the fragments of stone is obtained if the clay "slip" used is deflocculated with sodium silicate. With $3\frac{1}{2}$ p.ct. of ball-clay bond the mechanical properties of green and burned bricks are nearly equivalent to normal bricks with 2 p.ct. of lime bond. The general "working" properties of the clay-bond batch are similar to those of a lime-bond batch, except that the clay-bond batch is rather more sensitive to variations in water content.

(2) Under commercial conditions of burning there is very little difference in the rates of inversion of clay-bond and lime-bond bricks.

(3) The refractoriness of bricks with $3\frac{1}{2}$ p.ct. of clay bond is nearly equivalent to that of 2 p.ct. lime-bonded bricks of the same raw material and grading. Under-load subsidence commenced with $3\frac{1}{2}$ p.ct. ball-clay bonded bricks at Cone 27. The general behaviour under load does not appear to differ appreciably from that of 2 p.ct. lime-bonded bricks of the same raw material and grading.

(4) The spalling resistance of clay-bonded bricks is better than that of lime-bonded bricks of the same grading.

(5) Where bricks are exposed to slag or corrosive dust, the durability of clay-bonded bricks is less than that of lime-bonded bricks—especially when exposed to basic dust. In the early stages under such conditions the wear of the lime-bonded bricks is the faster, but later there is a reversal. In the roof of open-hearth furnaces there is little difference in durability; and in electric steel-melting furnaces the durability of clay-bonded bricks is the greater.

(6) In coke ovens the durability of clay-bonded bricks is indistinguishable from that of normal lime-bonded bricks. The trials indicate that the clay-bonded brick is as resistant to salt corrosion and mechanical wear as lime-bonded bricks of the same grading and heat treatment.

(7) Clay-bonded silica bricks are not generally superior to lime-bonded bricks for metallurgical purposes.

THE DISSOCIATION OF CARBON MONOXIDE IN CONTACT WITH REFRACTORY MATERIALS.

By D. W. HUBBARD, B.Sc., and W. J. REES, B.Sc.

It has long been known that carbon dioxide is converted into carbon monoxide by the action of heated carbon. Conversely, it is possible to convert carbon monoxide at high temperatures into carbon dioxide, with deposition of carbon. The authors investigated the latter reaction in connection with refractory materials.

It was found that at various temperatures between 260° and 570° C. the conversion of carbon monoxide into carbon dioxide was promoted by pure kaolin, pure silica, pure alumina, firebrick, and silica brick, as also by calcined clay, calcined dolomite, and pure ferric oxide—the reaction being continued up to 770° and 700° C. respectively in the case of the latter two.

The liberation of carbon, which is deposited in the pores, is apt to have a disintegrating action on the refractory.

DRYING CRACKS.

By CHRISTOPHER E. MOORE.

Drying cracks may be caused by irregularities in the drying, or may arise originally from faulty mixing, extruding, moulding, or pressing. The author discusses in a general way the factors involved in drying bricks or other goods so as to avoid cracking during the process.

MR. DUGALD CURRIE'S PRESIDENTIAL ADDRESS.

North of England Gas Managers' Association, Oct. 5.

I again wish to tender you my best thanks for the honour you have conferred upon me by electing me to the presidential chair for the ensuing year. In looking over the list of Past-Presidents of the Association, it is interesting to note that the first President—in 1877-78—was the late Mr. W. J. Warner, who at that period was Engineer to the South Shields Gas Company. Again, in 1891-92, we find that South Shields provided a President in the person of the late Mr. Robert Wallis, J.P., who served as a Director of the South Shields Gas Company for the long period of half-a-century, during forty years of which he filled the position of Chairman.

In 1896-97, the late Mr. J. H. Penney, then Secretary of the South Shields Gas Company, occupied the chair; and it is worthy of note that Mr. Penney held the position of Secretary for forty years, and altogether served the Gas Company for fully 51 years. My predecessor, the late Mr. T. H. Duxbury, was the President in 1909-10; so that during the half century the Association has been in existence, South Shields has had its full share of the honours.

It does not require a close perusal of the list of Past Presidents to observe the many gentlemen of outstanding ability who have occupied the presidential chair of this Association; and knowing my own limitations, I trust that when my year of office comes to an end I may feel that the interests of the Association have not suffered.

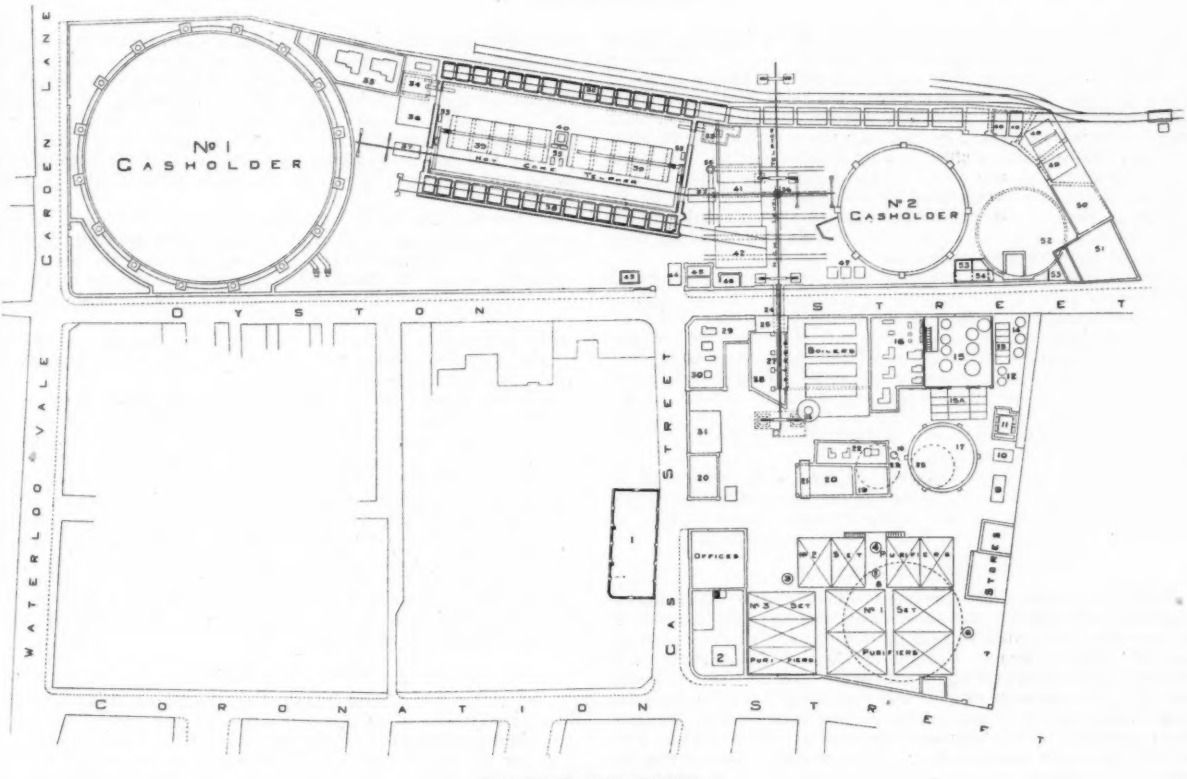
Regarding the subject-matter of my presidential address, after due consideration I have decided to give you some particulars of engineering problems dealt with at the South Shields Gas-Works during the past nine years.

Overcoming Pressure Difficulties.

In taking up my appointment in the early part of 1919, it was soon brought to my notice that, owing to lack of storage capacity at adequate pressure, great difficulty was experienced at times in maintaining a satisfactory pressure of gas throughout the Company's area of supply. The maximum daily consumption at that period was 3½ million c.ft., while the total working capacity of the holders at both the South Shields and the Jarrow Gas-Works only amounted to 2,300,000 c.ft. It will be apparent that when the gasholders became uncupped a serious fall in pressure took place, with results unsatisfactory to the consumers and the Company alike.

Prior to 1914 the Company acquired a piece of land in the Tyne Dock district, which it was proposed to utilize as a gasholder station; but owing to the war, the construction of an additional holder was not proceeded with. When the matter again came under consideration, in 1919, the abnormal cost of providing an additional holder was such that other means had to be thought out and adopted to overcome the disability from which we suffered. Fortunately, a large main varying in diameter from 24 in. to 16 in. had been laid between the South Shields and the Jarrow Works—a distance of fully 3½ miles—and this was used for passing gas from one works to the other.

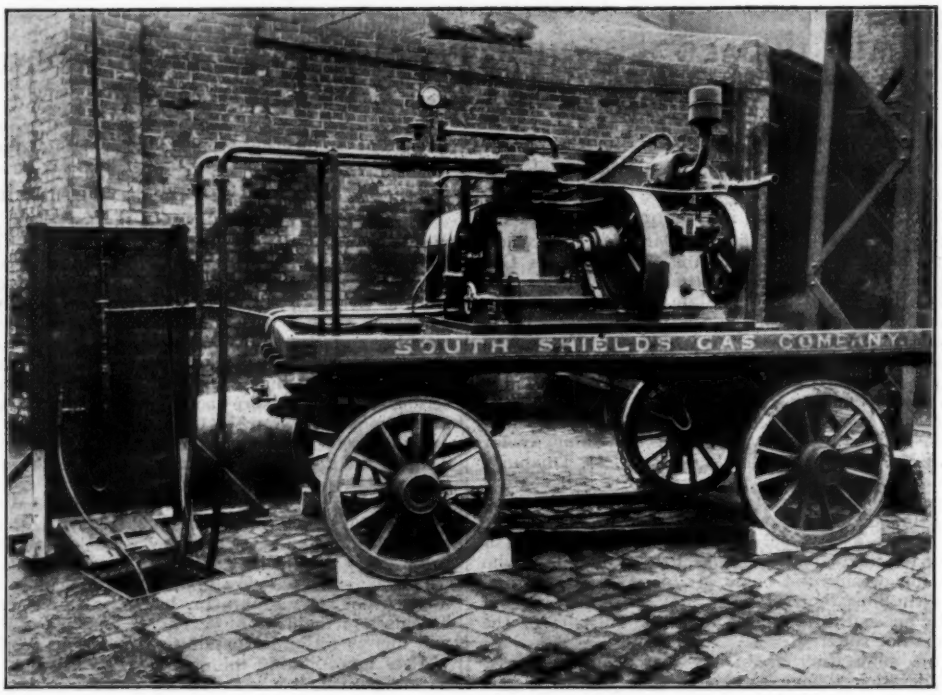
After investigating the possibility of utilizing this main as a boosting main, it was eventually decided to do so, and to instal



PLAN OF THE WORKS.

KEY TO WORKS' PLAN.

1. New mechanic's and blacksmith's shop.
2. Station meter (coal gas).
3. Centre valve (catch purifiers).
4. ,, ,, (C.W.G. ,,).
5. Rotary meter (,, ,,).
6. Centre valve (coal gas ,,).
7. Revivifying floor and shed.
8. Underground tar and liquor well.
9. Rotary scrubber.
10. Tower scrubber and tar extractor.
11. Livesey washer.
12. Condensers to ½ million C.W.G. plant.
13. Separator.
14. Condensers to 1½ million C.W.G. plant.
15. C.W.G. plant.
15A. Coke platform.
16. Exhausters, blowers, &c., with water tank and stores above.
17. Combined relief holder and oil storage tank.
18. P. & A. tar extractor (for C.W.G.)
19. Pump house.
20. Store.
21. Elevated tar tank.
22. Compressor house.
23. Underground wells.
24. Bridge and breeze tramway over Oyston Street.
25. Elevated water tank.
26. Boiler house chimney.
27. Breeze gantry to boilers.
28. Breeze retaining wall.
29. Booster.
30. Station governors.
31. Iron store.
32. Coal store.
33. Coal breaker (driven with steam engine).
34. ,, ,, ,, ,, gas ,,
35. Electricity generating plant.
36. Messrooms.
37. Quenching tanks.
38. Coke bunkers and crane gantry.
39. Horizontal retorts.
40. Chimney to retorts.
41. Screening plants.
42. Coke bunkers.
43. Time office.
44. Weighbridge.
45. Weigh office.
46. Workmen's conveniences.
47. Condensers (coal gas).
48. Elevated acid tanks.
49. Elevated liquor tank.
50. Sulphate store.
51. ,, plant.
52. Water storage tank for quenching.
53. Cooling tanks.
54. Condensers to sulphate plant.
55. Tar towers.
56. Rails and turntables for bogies carrying coke skips.



OIL-SPRAYING PLANT.

suitable boosting plant at both works. Each booster consists of one 900 mm. single-stage Rateau type fan capable of passing 500,000 c.ft. of gas per hour at a differential pressure of 20 in. water gauge. The fans are driven by De Laval steam non-condensing turbines of 40 B.H.P. running at 2500 R.P.M. with steam pressure at 80 lbs. per sq. in.; the speed of the turbines and gas pressure being regulated by sensitive diaphragm regulators connected to the outlet of the boosters and attached to the steam throttle valves fixed on the steam inlet pipes to the turbines. Sensitive loaded by-pass valves are provided between the inlet and the outlet of the fans which automatically open when the boosters are not in use.

The boosting main is connected at two points between South Shields and Jarrow to the ordinary distribution mains, district governors being installed to regulate the pressure. When the booster at either works is in operation, the pressure at the inlet of the governors is increased to whatever pressure is desired, and at the same time gas at the increased pressure is delivered from the works to the district governors by means of the boosting main. It is also possible at any time to pass gas from the holders of one works to the holders at the other, even while boosting is taking place.

Since the plants were installed, in 1920, the question of deficient pressure in the area of supply has become a thing of the past; and at present—and, I hope, for some time to come—we only have a passing interest in the cost of gasholders.

Naphthalene Troubles.

Having overcome the pressure difficulty, the next matter requiring immediate attention was the trouble caused by naphthalene in the mains and service pipes. To deal with the trouble, Messrs. Bryan Donkin & Co., of Chesterfield—who had supplied the boosting plant—were approached as to the feasibility of constructing a self-contained portable spraying plant which could be placed on an ordinary lorry and moved from place to place in our area of supply. The design of such a plant was soon forthcoming; and as it met with our requirements in every respect, an order was immediately placed for it. The apparatus consists of a single-acting vertical reciprocating compressor, driven direct by a 4-H.P. Lister vertical gas engine through a Hele-Shaw friction clutch. The compressor has a capacity of 750 c.ft. of gas per hour, against a pressure of 50 lbs. per sq. in. The compressor and engine are mounted on a cast-iron underbed bolted to a steel tray and frame for carrying the whole plant. This frame carries the paraffin or benzole tank for the sprayer, as well as the water vessels for cooling the gas engine and the compressor cylinders. The cooling water is circulated by a small centrifugal pump driven by the gas engine shaft. The gas connections are so arranged that, when starting-up the plant, the engine is supplied with gas from the inlet side of the compressor; but after the plant has been started, the gas engine can be fed from the compressor outlet, through a high-pressure service regulator which reduces the outlet pressure to suit the engine supply.

In preparation for applying the spray, the area of supply was divided into sixteen districts, and at each selected point a brick-lined pit was constructed round the main; the brick walls being surmounted by a large cast-iron surface box. The gas main at each point was drilled and tapped for a 1¼-in. diameter wrought-iron pipe which is permanently fixed to the main within the pit, and is provided with a special full-way valve which permits of the spraying device being inserted into the main. Also within the pit a 1¼-in. diameter pipe provided with a suitable cock is permanently attached to the main for supplying gas to the compressor and to the gas engine. The connections between the main and the spraying plant are made with flexible metallic tubing.

In practice the lorry containing the spraying plant is conveyed by horse to the district desired to be sprayed, and left in close proximity to the surface box containing the permanent connections already described. The man in charge of the apparatus then inserts the spraying device into the main through the special valve, the fitment being screwed into the valve to make a gas-tight joint. The flexible tubes are then connected to the spraying device and the gas supply pipe respectively, when the plant is ready for action.

It is our usual custom to spray the mains during the heaviest periods of consumption, as we find the benzole or paraffin vapour, as the case may be, carries much further when adopting this method. In the course of a few months from the inception of district spraying, we found considerable relief from naphthalene complaints; and as the system has been in operation for fully seven years, I am pleased to say that naphthalene troubles now cause us little anxiety. I should also like to mention that we find district spraying most beneficial as regards the keeping of meter diaphragms in good condition. If for no other reason than the latter, I consider the little plant I have described well worthy of a place in the equipment of a gas distribution department.

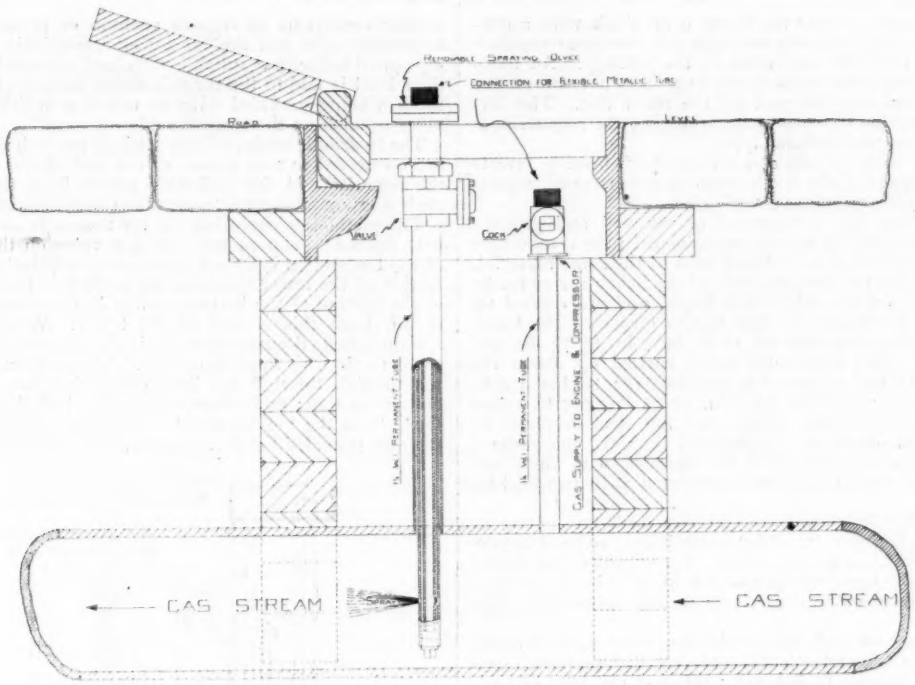
Water Gas Plants.

The water gas plants installed at the South Shields Works in 1921 consisted of a Humphreys & Glasgow carburetted water gas plant capable of producing 650,000 c.ft. of carburetted water gas per 24 hours, and a Dellwik blue water gas plant. The latter plant being completely worn out, due to constant use during the war period, it was decided to replace it with a new Humphreys & Glasgow carburetted water gas plant of 1½ million c.ft. capacity.

As most of you are familiar with the design and construction of this type of plant, it is unnecessary for me to give a detailed description of the plant, except to state that it is equipped with air and steam meters, together with an indicating pyrometer fixed in the superheater—all of which assist in efficient and economical working.

When installing this plant the opportunity was taken of providing a blower or blast plant of sufficient capacity to operate both plants if desired. The blowing plant consists of the usual design of fan driven by a 55-B.H.P. non-condensing De Laval steam turbine when running at 1500 R.P.M. with a steam pressure of 100 lbs. per sq. in. The fan and turbine are secured to a substantial cast-iron base, and are connected together by means of a flexible coupling; the reduction gear and lubrication generally being under pressure, and supplied by an oil pump situated in the container inside the base casting.

The two blowers installed with No. 1 plant in 1907 were,



ARRANGEMENT OF PERMANENT CONNECTIONS TO MAINS FOR OIL SPRAY.

during the reconstruction, provided with special automatic valves to prevent oscillation and loss of power when worked together as a stand-by to the new blower.

On the operating floor a substantial desk is provided for the operator. The desk is equipped with a clock indicating in seconds; an oil meter for measuring the quantity of oil supplied to the carburetter; steam meters showing the pounds of steam per minute being supplied to the top or bottom of the generator as the case may be; an air meter showing by gauge the amount of air supplied to the generator; an oil gauge indicating the pressure of oil per sq. in.; and a steam gauge showing the steam pressure.

When the new plant was completed and had been working for a short time, a guarantee test was carried out over a period of 24 hours. During the test, hourly readings of the barometer were taken, as were also the temperature and pressure at the meter and the make of gas per hour. The gas was tested for calorific value every half-hour, and the operator's working sheet recorded the quantity of oil used, as well as the duration of "runs and "blows" and the time occupied in coking and clinkering. A chart which automatically recorded the working of the plant was used for checking purposes.

All coke supplied to the plant was weighed, and tested for ash and moisture content; and the ashes resulting from clinkering operations were also carefully weighed.

The temperature of the superheater during the test was maintained at approximately 1300° Fahr. as indicated by a "Cambridge" electrical pyrometer.

The average results obtained were as follows:

Gas made	1,363,000 c.ft. (corrected)
Calorific value	456 B.Th.U.
Oil used per 1000 c.ft.	1·54 galls.
Inerts in gas	8·37 p.ct.
Coke used per 1000 c.ft., including ash and moisture	37·6 lbs.

Coke Handling.

Prior to the installation of the new C.W.G. plant, the method of handling the coke from the yard to the operating floor was by means of a hydraulic lift. This meant that an appreciable quantity of coke was always lying in the yard opposite the C.W.G. house, which caused a good deal of congestion and inconvenience to the workmen when clinkering the generators, besides impeding the speedy removal of clinker and ashes. The lift itself was so slow that it required to be in continuous operation when both plants were at work.

To remove these difficulties, an elevated coke storage platform was designed, and erected in front of the C.W.G. house. When designing the platform, use was made of the steel stanchions which form part of the framing of the front wall of the C.W.G. house. It was, therefore, only necessary to provide four additional stanchions opposite those forming the front framing of the house; and by means of steel beams of **H** section, the framework for the platform was easily and suitably provided. The floor of the platform is of reinforced concrete, the finished level being exactly the same as the operating floor level. The back and ends of the platform are enclosed by means of a 9-in. brick wall 7 ft. 3 in. in height; the wall being supported by suitable steel framework.

A semi-circular roof was constructed over the platform above the level of the eaves of the C.W.G. house, to serve the dual purpose of protecting the coke from rain and also to provide means for handling the coke from the yard to the platform. The principals of the roof are of the lattice type, and are of sufficient strength to carry a safe moving load of 3 tons. To the underside of the principals, at the centre, is fixed a 12 in. by 6-in. **H**-section runway beam which extends the full length of the platform and projects over one end a sufficient distance to enable a skip of coke to be lifted from the yard level.

The lifting apparatus consists of an electrically driven hoisting and travelling block capable of hoisting 30 cwt., at a speed of 36 ft. per minute; the travelling speed being 150 ft. per minute. The hoisting and travelling motors are of 5 B.H.P. and 1 B.H.P. respectively. The coke is conveyed by horse and cart in a special self-emptying and self-righting skip from the storage hoppers in the yard; the skip being lifted by the hoist block and tipped on the storage platform where desired.

The full capacity of the platform is 38 tons, which is capable of supplying both C.W.G. plants over a period of fully 24 hours. At each corner of the platform, next to the C.W.G. house, mild-steel hoppers are provided for the storage of breeze separated from the coke; the hoppers being emptied periodically into carts, and the breeze being conveyed to the boilers. During the coal stoppage in 1926, when both C.W.G. plants were in operation, the coke storage platform proved its usefulness, enabling the plant to be worked with the utmost smoothness, and resulting in a large saving in the cost of handling the coke.

Reconstruction of Carbonizing Plant.

The next important work carried out was the complete reconstruction of the coal carbonizing plant. The plant existing in 1923 consisted of two benches of inclined retorts, each bench having six settings containing eight retorts, or a total of 96 retorts. The inclined retort installation was erected in 1901 and 1902; and in the year under review the plant was in such a condition that even a large expenditure of money to carry out the necessary repairs and renewals would not have been justified, having regard to the economic results that might be expected from this type of plant.

It was therefore decided to replace the plant with modern settings of machine-operated horizontal retorts, the work to be carried out over a period of two years.

No. 1 bench, containing six settings of inclined retorts, was put out of action on April 2, 1923; the demolition work being put in hand immediately. When the bench concrete foundation was reached, it was found to be in good condition, and of ample area to contain the proposed new bench.

The new bench constructed consists of five settings of horizontal through retorts, each setting containing ten retorts in two vertical rows, the retorts being 24 in. by 18 in. in section, and 20 ft. in length. The settings are 9 ft. 6 in. in width; the arches being semi-circular, constructed of two rings of purpose-made arch bricks, the inner ring being 9 in. thick and the outer ring 4½ in. thick. The division walls between the settings are 1 ft. 11 in. thick, built throughout of firebrick; the end or pier walls being 3 ft. in thickness and built of common brickwork, except the inner 9 in., which is of firebrick. The haunches of the arches and bench backing are built of common brick faced with firebrick.

The main flue is constructed in the centre of the bench; the

side walls and semi-circular top being 9 in. thick with a continuous division wall running through the centre to separate the gases from the back and front of the settings. An automatic draught regulator was fixed near the bottom of the chimney for controlling the pull on the main flue. The furnaces are designed on the step-grate principle; the regenerators being of the rectangular tubular type.

Four settings were provided with moulded fireclay retorts made in three lengths; the combustion chambers and supporting walls being constructed of Scotch silica.

The fifth setting was constructed of tongued and grooved segmental silica retorts of Scotch manufacture; the combustion chambers and supporting walls being built of the same material.

The buckstays on the charging side of the bench are 20 in. by 7½ in. by 89 lbs. per ft. rolled steel joists, and are carried up above the bench to support the coal hopper girders. The buckstays on the discharging side are 18 in. by 7 in. by 75 lbs. per ft. rolled steel joists; these also being carried up above the bench to support the girders for carrying the telpher track. The end buckstays are 18 in. by 7 in. by 75 lbs. per ft. rolled steel joists fitted with base angles and top steel eyeplates to receive four 2½-in. diameter longitudinal tie rods, the ends of which are swelled and screwed 3 in. diameter with right and left hand thread respectively, and connected with turnbuckles for adjustment.

The cross girders between front and back buckstays are 12 in. by 6 in. by 44 lbs. per ft. rolled steel joists, secured to the buckstays by steel clips and brackets. These girders are stayed on each side of the bench by means of 6 in. by 3 in. rolled steel joists framed between the girders and secured with angle clips and bolts.

The mouthpieces on each side of the bench are secured to the retorts with ⅞ in. diameter bolts, and are also supported and stayed with six lines of 80 lbs. per yard steel rail held in position by steel clips secured to the buckstays and fixed by means of cotters. The cast-iron mouthpieces are ∩ shaped, and measure in section 24½ in. by 18½ in., the depth being 19½ in.

The ascension, arch, and dip pipes are all 7 in. internal diameter, and are fitted on both sides of the bench. The hydraulic mains are formed of mild-steel plates and angles, with division plates between each setting, and are constructed with curtain plates to enable each section to be easily cleaned when desired. A steel platform is provided at each side of the bench immediately behind the hydraulic mains, for access thereto; the platforms being at a suitable height to facilitate the cleaning of the sections.

The foul main runs along the centre of the bench, with branches on each side to connect to each section of hydraulic main. The retort house governor is fixed immediately over the end of the bench, which enables an extension from the lever arm of the governor to be carried down to within a few feet of the stage floor level, from which position all regulation of the governor takes place. The tar mains are 8 in. in diameter and are provided at convenient places with cleaning doors fitted with steaming connections which may be put into immediate operation at any time if required.

TAR TOWERS.

The bench is provided with four tar towers, two at each end, which are constructed of 15-in. by 4-in. rolled steel channels and ⅜ in. thick mild-steel plates riveted together, each tower being divided into two sections by means of a mild-steel division plate. The bottom section measures 4 ft. by 1 ft. 3 in. by 6 ft. in height, the top section being 4 ft. by 1 ft. 3 in. by 16 ft. 3 in. in height above the division plate. Doors are provided near the bottom of each section for cleaning purposes.

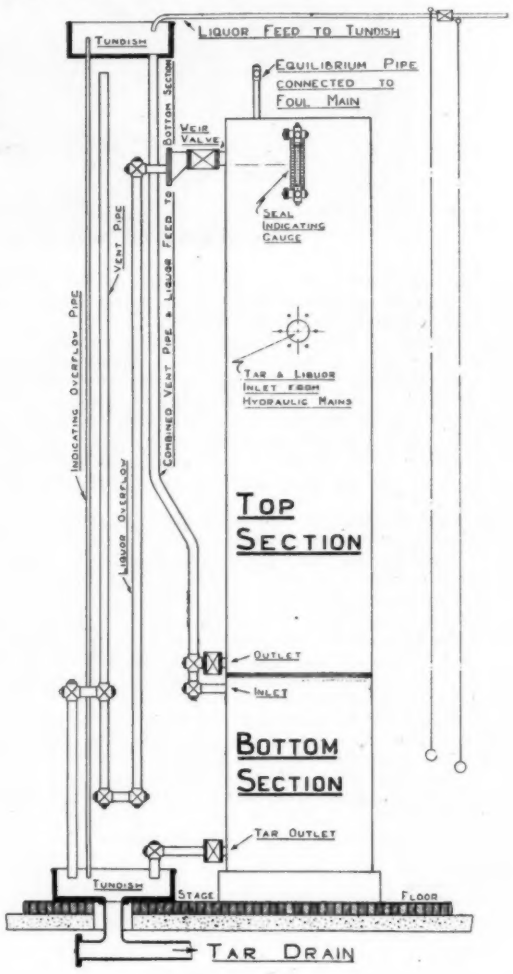
The tar run-off connection, which is provided with a plug valve, is 3 in. in diameter, and is fixed at the lowest point of the bottom section. The inlet of the bottom section, which is not provided with a valve, is situated as near as possible to the top of the section and adjacent to the bottom outlet of the top section. Both connections are 3 in. in diameter; the top section bottom connection being fitted with a suitable valve. Both these connections are joined together by means of cross-pieces and a connector, and a combined 3 in. diameter liquor and vent pipe is carried from the cross-piece opposite the bottom outlet of the top section to a tundish fixed above the top of the tower.

The tar and liquor from the hydraulic main enters the tower about 9 ft. 6 in. from the bottom of the top section, while near the top of the tower, and at approximately the same level as the bottom of the dip pipes, an overflow valve of the weir type is fixed with indicator for showing to what extent the valve is opened. A special cast-iron outlet is fixed to this valve, to which is attached the liquor overflow pipe which drops to within 3 ft. of the stage floor, where a syphon seal is formed with an air vent carried up 1 ft. 6 in. above the top of the tower. The overflow runs into a cast iron tundish fixed at the stage floor level, the outlet from the tundish flowing to the tar well.

The adjustment of the seal on the dip pipes is facilitated by the provision of a 2-in. diameter glass gauge provided with stop cocks and a scale which is fitted near the top of the tower in close proximity to the seal regulating valve. From the top of the tower a 2-in. diameter equilibrium pipe is carried to the foul main at the inlet of the bench governor, to ensure that similar conditions as regards vacuum or pressure exist in the hydraulic main and the tar tower respectively. A liquor feed pipe provided with a suitable valve and operated from the stage floor level is laid to the tundish above the top of the tower; the tundish being provided with an overflow which is led into the other tundish on the stage floor level.

The hydraulic mains of two settings on each side of the bench are connected to two towers at one end of the bench, while at the opposite end the hydraulic mains from three settings on each side are connected to two tar towers respectively.

The method of operating the tar towers is as follows: When it is desired to run-off tar, the plug valve on the bottom outlet of the top section is closed, thus completely isolating the bottom section of the tower from the top section. The tar outlet valve at the bottom of the bottom section is then opened until all tar is run from this section of the tower. When this has been accomplished, the run-off valve is closed, and the liquor supply valve to the top tundish opened. Liquor then flows from the top tundish through the inlet connection near the top of the bottom section; and when the section is full, the liquor overflows from the top tundish to the bottom tundish by means of the pipe provided for that purpose, the overflowing of the liquor



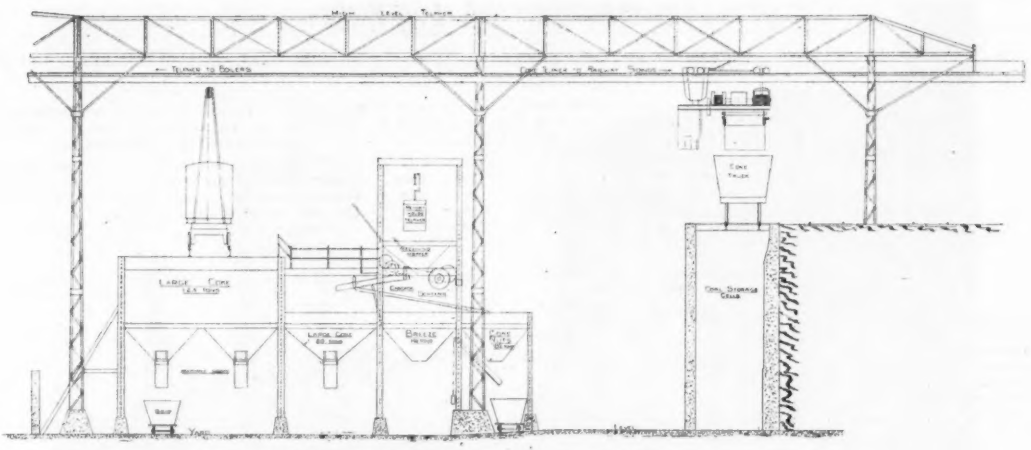
TAR TOWER.

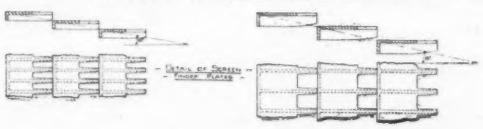
indicating that the bottom section of the tower is completely full. The liquor supply is then turned off, and the outlet valve at the bottom of the top section opened, thus putting both sections of the tower into communication with one another. It will be readily understood that during the running-off process the seal of the dip pipes is undisturbed, and that no exact regulation of tar run-off or liquor feed is required.

The stage floors are constructed of rolled steel joists and concrete; the paving being made with special hard fireclay bricks placed on edge. The floor on the charging side is 19 ft. wide, and on the discharge side 17 ft. wide; both floors being provided with suitable rails for the charging machine and the travelling hot coke producer feeding chute.

The coal hoppers of the inclined retort installation, together with the coal elevating and conveying plant, were retained and adapted for the new arrangement; the flat bottoms of the hoppers being removed, and new **V**-shaped bottoms constructed to suit the requirements of the stoking machine, and to provide additional coal storage accommodation. In this connection, I may say that the storage capacity of the hoppers was increased from 233 tons to 291 tons.

It should be mentioned that the old buckstays on the charg-





COKE SCREENING PLANT.

ing side of the inclined retort installation had to be left in position to support the coal hoppers until such time as the new buckstays were erected and fixed to the hopper girders. It was therefore unnecessary during the reconstruction to disturb the coal hoppers or any part of the coal handling plant.

Charging and Discharging Machine.

The combined charging and discharging machine is electrically driven throughout, each motion having a separate motor, and all the controlling mechanism being conveniently arranged on the operators' platform.

The machine was designed and constructed by Messrs. Drakes, Ltd., of Halifax; and as this machine is so well known to the gas industry, it is unnecessary for me to give minute details of its construction. The charger is of the rotor fan type; the discharger consisting of a series of heavy plate links which, when not in action, are housed in a specially-designed drum fixed to the platform of the machine. The charger motor is of 17 B.H.P. and runs at from 560 to 1250 R.P.M., the discharging ram motor being 10 B.H.P. at 575 R.P.M. The travelling and hoisting motors are each of 7 B.H.P. at 545 R.P.M. At the end of the retort bench, and fixed to the end buckstays, a steel folding table in sections is provided to enable the ram to be run out for periodic examination and lubrication.

The coke telpher track inside the retort house had to be entirely reconstructed to suit the altered conditions in the house. The new track is 288 ft. in length, and consists of a line of 14 in. by 6 in. by 46 lbs. per ft. rolled steel joists with a 3 in. by 3 in. by 30 lbs. per yard flanged bottom rail fixed to the top flange of the runway joists upon which the telpher machine travels. The track is supported inside the retort house by cross girders fixed to the front buckstays at one end and built into the side wall of the retort house at the other end, from which hangers are attached to support the rolled steel joist brackets which are fixed to the buckstays and the runway track respectively. Outside the retort house the track is carried by steel-framed trestles securely fixed to concrete foundations and suitably braced.

The old telpher machine, which has a lifting load of 35 cwt. and is capable of lifting the coke from two retorts, was completely overhauled and used on the new track. The hoisting motor is of 11 B.H.P., and the travelling motor of 9 B.H.P.; both being controlled by a tram type pillar controller. The coke skips are of the self-emptying and self-righting type operated by a cord from the driver's cabin.

The coke quenching arrangement consists of an elevated cast-iron tank, fixed between the end wall of the retort house and the first set of trestles, into which the skips containing the hot coke are partially immersed until the coke is sufficiently cool to place in the receiving hopper of the screening plant.

Coke Screening and Storage.

In the yard opposite the end wall of the retort house, coke screening and storage hoppers were erected to replace similar plant which was in a worn-out condition. The hoppers are constructed of mild-steel plate and angles, and are supported by steel stanchions at such a height as to give a clearance of 10 ft. 6 in. between the discharge doors and the ground level, to permit of all sizes of steam and motor lorries to pass freely underneath. Over the hoppers two double-decked cascade coke screens are fixed, each working independently of the other and having separate motors of 5 B.H.P. The screens are of the jigging type set at an angle of 10°; the screening portion being formed of cast-iron finger-plates—the distance between the fingers regulating the size of the coke passed over the screen. The top screen of each set passes coke 2 in. and over into a storage hopper, while all material under 2 in. in size is dealt with by the bottom screen, which removes breeze up to ¾ in.; the material passing over this screen into a storage hopper being nuts varying in size from ¾ in. to 2 in. A mild-steel firebrick-lined receiving hopper is constructed above the screens, underneath which two sure-feed reciprocating feeders operate to give a constant feed of coke to the screens.

The original method of handling coke in the storage yard was by means of an elevated steam crane supported upon and running over concrete storage cells which run the full length of the retort house. To facilitate the handling of coke from the storage hoppers already described, the track of the steam crane was extended over the steel hoppers; and by means of adjustable chutes and skips, coke can be removed from all the hoppers to the storage yard with a minimum of trouble and expense. Arrangements have also been made which enable coke from the storage yard to be delivered into the receiving hopper and passed through the screening plant in the usual way.

Running at right angles to the retort house telpher track, a high-level telpher track existed for loading coke from the yard to the railway sidings situated about 32 ft. above the yard level. The high-level telpher track was equipped with a telpher machine capable of lifting a total load of 35 cwt., which was found of inadequate capacity when dealing with coke shipment orders. It was therefore decided to instal a telpher machine capable of lifting a total load of 3 tons at a speed of 60 ft. per minute which would enable coke under favourable conditions to be loaded on rail at the rate of 30 tons per hour.

The increased weight put upon the telpher structure had to be taken into consideration, and it was found after examination and calculation that considerable strengthening of the structure would require to be carried out, particularly to the lattice box girders to which are attached the brackets for supporting the runway beams. I should mention that the distance from the yard level to the running rail level of the track is approximately 56 ft.; the track being in two spans each measuring 59 ft. The strengthening work was carried out without taking down any part of the structure; each individual member forming the lattice girders being inspected and provided with new gusset plates at joints, and the structure being otherwise strengthened by the fitting of additional bracing members. The hoisting motor of the telpher machine is of 18 B.H.P., and the travelling motor of 7½ B.H.P. While dealing with this telpher track, I may mention that an additional span measuring 85 ft. in length was constructed and extended to our boiler house site to convey breeze to the boilers, and purification and other materials to this part of the works.

Second Section of Horizontals.

The second section of the inclined retort installation was shut down on April 12, 1924, and the demolition work was immediately commenced. No. 2 bench of horizontal retorts is constructed in all respects similar to No. 1 bench, except that all the retorts installed were of moulded fireclay supported on silica walls.

The time occupied in carrying out the reconstruction of the carbonizing plant was as follows:

No. 1 bench of inclined retorts was put out of action on April 2, 1923; No. 1 new horizontal bench being completed, and gas-making on Oct. 9, 1923.

Comparative Labour Costs of Gas-Making.

	INCLINED RETORT INSTALLATION.			HORIZONTAL RETORT INSTALLATION.		
	12 Settings each containing 8 Retorts, a Total of 96 Retorts. (8 Hour Charges with 3 Shifts of Workmen).			10 Settings each containing 10 Retorts, a Total of 100 Retorts. (12 Hour Charges with 2 Shifts of Workmen.)		
	Gas made per 24 hours . . . 1,350,000 c.ft.			Gas made per 24 hours . . . 2,250,000 c.ft.		
	Coal carbonized per 24 hours . 121 tons			Coal carbonized per 24 hours . . 168 tons		
	Gas made per ton of coal (average) 11,161 c.ft.			Gas made per ton of coal (average) 13,342 c.ft.		
	Calorific value (B.Th.U. per c.ft., average) . . . . . 482·7			Calorific value (B.Th.U. per c.ft., average) . . . . . 484·9		
	Number of Men.	Rate of Pay.	Amount.	Number of Men.	Rate of Pay	Amount.
		s. d.	£ s. d.		s. d.	£ s. d.
Coal elevator men	2	9 7½	0 19 3	2	9 7½	0 19 3
Stokers	18	10 10	9 15 0	10	10 10	5 8 4
Pipemen	6	10 10	3 5 0	..	..	..
Producermen	3	10 3·25	1 10 9	2	10 3·25	1 0 6½
Telphermen	3	10 1·75	1 10 5	2	10 1·75	1 0 3½
Coke screen attendants . . .	3	9 0·75	1 7 2	2	9 0·75	0 18 1½
Cranemen	2	9 7	0 19 2	2	9 7	0 19 2
Totals	37	..	19 6 9	20	..	10 5 8½
Cost per ton of coal carbonized	..	..	0 3 2·35	..	..	0 1 2·69
Cost per 1000 c.ft. of gas made	..	..	0 0 3·43	..	..	0 0 1·09

No. 2 bench of inclined retorts was put out of action on April 12, 1924; the second new bench being completed, and gas-making on Oct. 2, 1924.

Having regard to the magnitude of the work carried out, including the erection of the coke handling and screening plant, great credit is due to the contractors, Messrs. Drakes Ltd., not only for the expeditious manner in which the work was carried out, but for the excellence of the material and labour supplied.

The working of the new plant has given complete satisfaction in every respect, the heat regulation of the settings being easily performed. No difficulty has been experienced in maintaining an even temperature throughout the entire length of the retorts. The working temperature varies between 1350° and 1400° C.; and though working continuously at this temperature, the moulded fireclay retorts did not appear to suffer unduly. Since we commenced resetting the retorts, we have, however, adopted tongued and grooved segmental silica retorts made at Consett; and from our experience—so far as it has gone—we are satisfied that this particular material and make of retort are a decided advance on anything we have hitherto used.

The above table gives particulars of the labour costs of gas-making with the new plant in comparison with those of the old inclined retort installation, assuming the latter was in operation to-day, the rates of pay in both cases being the current rates payable.

It will also be observed from the table that the gas production of the retort house has been increased by 66·66 p.ct., though the new installation contains only four additional retorts.

The gas yield per ton of coal carbonized shows an increase of 2181 c.ft., or 19·54 p.ct., based on the average results obtained with the inclined installation during the period from Jan. 1, 1922, to Dec. 31, 1922, and in the case of the new plant over the period from Jan. 1, 1927, to Dec. 31, 1927.

On the thermal basis the average production over twelve months' working represents 64·69 therms per ton of coal carbonized with the new plant as compared with 53·87 therms with the old inclines; the increase being 10·82 therms, or 20·08 p.ct. A yield of 64·69 therms may not attract much attention in view of the high results obtained in some quarters to-day; but in considering thermal yields, various factors have to be taken into account, such as quality of coal used, local conditions, and last—but not least—the lowest cost at which gas of good quality can be put into the gasholders.

To enter upon a reconstruction scheme such as I have outlined requires a good deal of courage and confidence; but with a Chairman and Board of Directors possessing high business ability and enterprise willing at all times to give unstinted encouragement to all those concerned in the carrying through of the scheme, the work became a pleasure instead of an arduous task.

FRASERBURGH GAS-WORKS.

[From the September issue of "West's Gas."]

Fraserburgh now possesses a new gas-works the equipment of which is of the most modern type and is capable of coping with the increasing demands of the district for a long period. The present sale of gas is about 40 million c.ft. per annum, of which 54 p.ct. is prepayment domestic, 30 p.ct. ordinary domestic, 13 p.ct. industrial load, and 3 p.ct. public lamps. In recent years, due to the expansion of the burgh, the old gas-works, situated in the centre of the town, have been unable to deal with the demand. A new site had been acquired some years ago, on which a gas-holder, of a capacity of 140,000 c.ft., had been erected; and last year it was decided to proceed with the construction of a complete new works on this site to the design of Mr. Lawrence Hislop, Consulting Engineer.

West's Gas Improvement Company were entrusted with the major portion of the work, including the vertical retort installation, boiler house, exhauster and engine houses, &c. The carbonizing plant, which is capable of a daily output of 320,000 c.ft. of 450 B.Th.U. gas, consists of four 40-in. steaming type Glover-West vertical retorts built of silica material, arranged all in one row, each retort being separately heated and controlled. Each is designed with its own gas offtake and valve and individual extractor gear, so that every retort is an entirely independent unit. Two producers are provided of the step-grate type, each capable of supplying fuel gas to the four retorts, so that one acts as stand-by to the other. Producer gas with 29 p.ct. CO content is continually maintained by merely poking the bottom three bars once in 24 hours, and removing the ash from the bottom two bars once in the eight-hour shift.

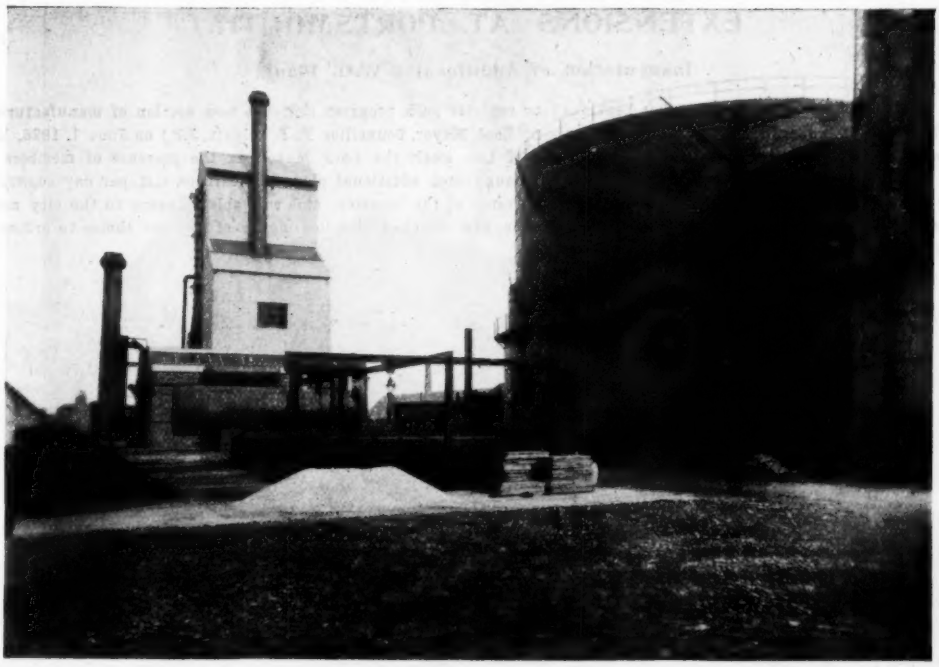
The coal and coke are handled by a 25-ton lip-bucket conveyor encircling the house, operated by the same gearing as the extractors. Coal, carted from ships or from the railway station, is dumped into an exterior receiving hopper and transported to the overhead bunkers. The provision of a chute from the bunkers to the yard enables coal to be stored in a speedy and efficient manner when a cargo arrives by sea.

The coke from the retorts can be either discharged into the conveyor below the bench and deposited into the producer feed hopper, or wheeled away to the yard in barrows. Two vertical steam engines, one acting as stand-by to the other, drive the extractor gear and conveyor.

A bar screen arranged inside the coke chute to the producer ensures the delivery of clean fuel, and the breeze thus formed is led by means of a duct from the screen into the boiler house, for use in steam raising. The boiler (28 ft. by 7 ft. Lancashire) is fitted with a breeze-burning grate, and supplies the whole of the steam required on the works; the boiler fuel consumption being cut down to a minimum by feeding with hot water at a temperature of 198° Fahr., delivered from a Weir feed-water heater, through which passes the exhaust steam from the exhausters and all the engines in operation.

The engine and exhauster house, wherein also the rotary station meter and recording instruments are placed, is adjacent to the boiler and retort houses, and this admirable arrangement makes it easy for the whole works to be operated by one man per shift, besides providing a highly efficient lay-out.

The erection of this work was commenced in February of this year, and gas from the new plant was turned on to the town in the middle of June. The following data were taken



during an observed period of 270 hours under normal working conditions.

Coal: Preston Grange doubles.
Observation period: 6 a.m., Aug. 9, 1928, to 12 noon, Aug. 20.
Weight of coal carbonized: 76 tons 16 cwt., or 3·41 tons per retort per day.
Number of retorts in operation: 2.
Steam to retorts: 9 p.ct.
Total gas made: 1,371,200 c.ft.
Gas per ton: 17,850 c.ft.
Quality: 450 B.Th.U.
Therms per ton: 80·32.
Total coke made: 45 tons 8 cwt.
Coke per ton of coal: 11·82 cwt.
Net coke to producers: 13 tons 1 cwt. 1 qr.
Percentage of coke on coal carbonized: 17 p.ct.

The water-cooled condensers and Livesey washer were supplied by Messrs. Henry Balfour & Co., of Leven, Fife; also the five purifiers, each 15 ft. by 10 ft. by 5 ft. deep, and the additional gasholder of a capacity of 160,000 c.ft.; the scrubber (500,000 c.ft. per diem) is by Messrs. W. C. Holmes & Co., Ltd., of Huddersfield. The tar dehydration plant, which is capable of dealing with 18 to 20 tons of crude tar per 24 hours, is of the "Cascade" type, and was supplied by Messrs. Clayton, Son, & Co., of Leeds.

The entire works were constructed under the able supervision of the Consulting Engineer; and Fraserburgh may justly claim that she possesses a gas-works, of its size, second to none in the world.

NORWEGIAN GAS-WORKS ASSOCIATION GROUP.

THROUGH the courtesy of Mr. John Irminger, Engineer and General Manager of the Corporation Gas-Works at Bergen, we are enabled to publish the accompanying photograph of a party taken at Totland, where is situated the generating station of the Bergen Corporation's Electricity Works, which were visited by the members of the Association. Mr. Irminger, who has recently been elected President of the Association, is seen, with his wife, at the right-hand end of the photograph. In the centre at top is a member of the Association who came from Iceland to attend the meeting; while at the bottom on the left will be recognized Mr. Walter Dunn. Next to him is Mr. Schutte, the newly-elected President of the German Association of Gas and Water Engineers.

EXTENSIONS AT PORTSMOUTH.

Inauguration of Additional C.W.G. Plant.

The Portsmouth Gas Company has continued to register such progress that the new section of manufacturing plant which was opened by the Mayor (the present Lord Mayor, Councillor F. J. Privett, J.P.) on June 1, 1926, has already needed supplementing; and on Wednesday of last week the Lord Mayor, in the presence of members of the City Corporation and a large party of visitors, inaugurated additional plant of 2 million c.ft. per day capacity. The Lord Mayor was presented with a handsome souvenir of the occasion, and was able to carry to the city news of a further decrease in the price of gas, which has now reached the low figure of 7d. per therm to ordinary consumers and 8d. through prepayment meters.

GENERAL OFFICES AND SHOWROOMS.

PROGRESS.

The extensions to the Hilsea Works, which were opened in 1926, and which were the subject of an illustrated article in the "JOURNAL" for June 9 of that year, were expected to prove sufficient for Portsmouth's requirements for a number of years, consisting, as they did, of an installation of Woodall-Duckham vertical retorts, with coal and coke handling plant, purifiers, a 2-million c.ft. gasholder, and subsidiary plant. In 1926 the Company's output of gas, which had shown over five years an annual average increase of about 100 million c.ft., amounted to some 2530 millions; and it is estimated that requirements for 1928 will approach 2750 million c.ft. Further, it was necessary in 1927 to cope with a maximum day's issue of something over 11 million c.ft.

There has, indeed, been for some years an annual increase in the neighbourhood of 6 p.ct. in the sales of gas; and this has accounted for the early addition to the Hilsea plant, which on this occasion has taken the form of a Humphreys & Glasgow carburetted water-gas plant of 2 million c.ft. per day capacity. This plant, together with other features of the Company's activities, was described in a brochure prepared for the occasion. From this we give extracts later in this article; and we are also able, by the courtesy of the Company, to reproduce some excellent photographs.

THE DISTRIBUTION DEPARTMENT.

The visitors assembled at the Rudmore Works, and were met by the Deputy Chairman of the Company (Mr. William Gillman, J.P.), Mr. W. Doig Gibb, O.B.E., M.Inst.C.E., Capt. R. J. E. Baker, and Dr. F. E. Beddow (Directors), Mr. Thomas Carmichael, M.I.Mech.E. (the Engineer), Mr. H. A. Stibbs, F.C.I.S. (the Secretary), and other officials. A welcome was offered to all by Mr. Gillman, and was acknowledged by the Lord Mayor (Councillor F. J. Privett, J.P.); and thereupon a most interesting tour of the workshops of the Distribution Department was made under the able guidance of Mr. S. E. Whitehead (the Assistant Engineer), and Messrs. A. J. Garward, D. T. Marwick, A. H. Mills, E. T. Stewart, C. B. Cassell, J. H. Redwood, and others of the department.

This section of the Company's work is described later in the extract from the brochure; but it may be said here how impressed were all the visitors by the careful organization and methodical treatment which were everywhere in evidence. Further, it is clear that welfare of the employees is uppermost in the minds of the management, for "safety first," hygiene, and comfort are not only preached but practised. In this regard it is noteworthy that an elaborate system of air ducts has been arranged in the shops to remove any gases released from meters under repair; and this feature can be seen in one of the photographs we reproduce. Similar exhaust ducts are fitted behind the buffing machines. The Company level the load on their shops by making their own meters when the rush of repair work eases off from time to time; and the high quality of the product was demonstrated by a labelled display of the many parts which constitute that wonderful instrument, the dry gas meter. Another interesting exhibit was a meter in work bearing the stamp "A. Wright, No. 13,570, 2 Lt., 1857." It also bears testimony to the effect that it was tested and found correct by the Portsea Island Gas Company, represented by Alfred Renny, Engineer; for in those days meters were bought by the consumer and submitted for test to the supplier.

In the cooker section the sequence of operations from the arrival of the soiled hire stove to its dispatch in renovated condition, was followed with interest; and it was learnt that all cookers in for repair are fitted with a complete new "high-efficiency" hotplate with ring burners. What the stove repairer can do was strikingly illustrated by an incoming "Eureka" standing beside an outgoing "Eureka" of the same pattern.

INAUGURATION OF THE NEW PLANT.

The visitors then motored to the Hilsea Works, which are 3½ miles distant from the centre of the city, and immediately made their way to the new water gas house. Here they were joined by the Chairman of the Company, Mr. T. H. F. Lapthorn, J.P., and Mr. J. F. Ronca, the Director of Gas Administration to the Board of Trade. Mounting to the operating floor, the party passed through to the blower house which is on the same level; and there Mr. Carmichael invited the Lord Mayor to start the plant by opening the steam valve to one of the 55 H.P. de Laval turbines. The Lord Mayor's remarks were drowned by the increasing roar of the fan; but plant for the production of a further 2 million c.ft. of gas a day was safely put into commission.

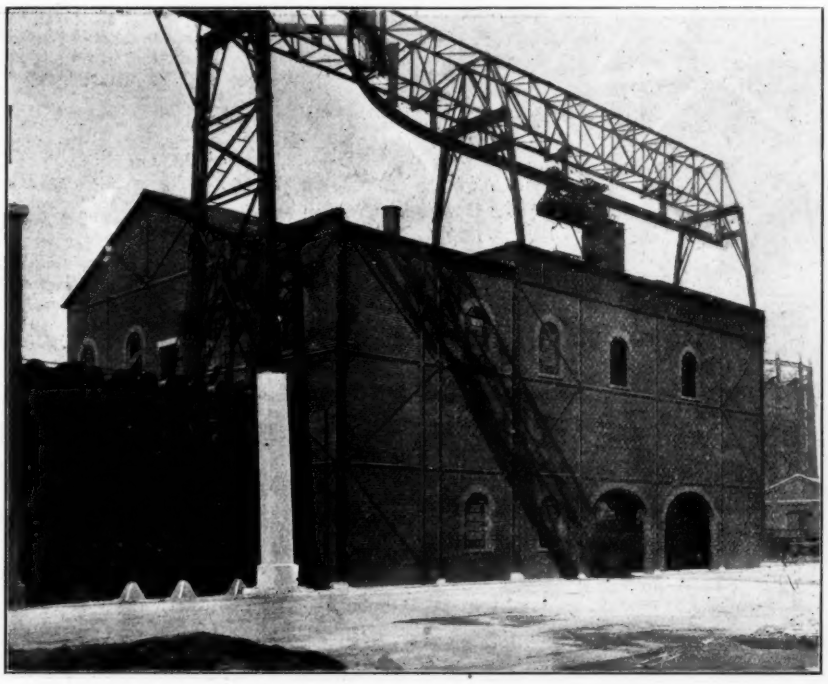
Some time was spent in examination of the details of the set, special attention being paid to the hydraulic charging machine; and then luncheon was served in the men's dining hall.

LUNCHEON.

The Chair was taken by Mr. T. H. F. Lapthorn, who was supported by the Directors and Officers of the Company. At the top table were the Lord Mayor, the Lord Mayor Elect, the Deputy Lord Mayor, other Corporation officials, and Mr. J. F. Ronca.

After the Loyal Toast,

The CHAIRMAN, in proposing the toast of "Our Guests," said that when the Lord Mayor and his colleagues honoured them with their



FRONT ELEVATION OF THE NEW C.W.G. HOUSE, WITH TELPHER PLANT AND ATMOSPHERIC CONDENSERS.

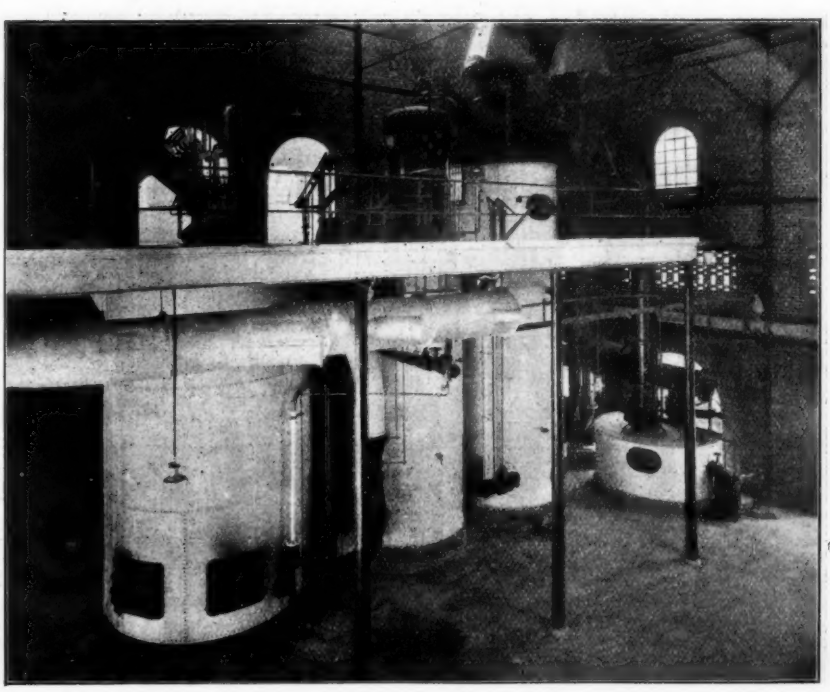
presence there a little over two years ago, they did not anticipate that they would have the pleasure of being able to ask them there again so soon; but the continued growth of their undertaking made it necessary for them to add still further to their plant. The Lord Mayor had started a new carbonizing plant, which brought their maximum output in those works from 8½ to 10½ million c.ft. In addition to that, their Flathouse Works gave them close upon four millions a day, so that their maximum capacity was now something over 14 million c.ft. Their largest output in any day in the history of the Company was on Christmas Day last, when it just passed beyond 11 millions, so that there was now ample capacity for the present demands upon them.

Gas at 7d. a Therm.

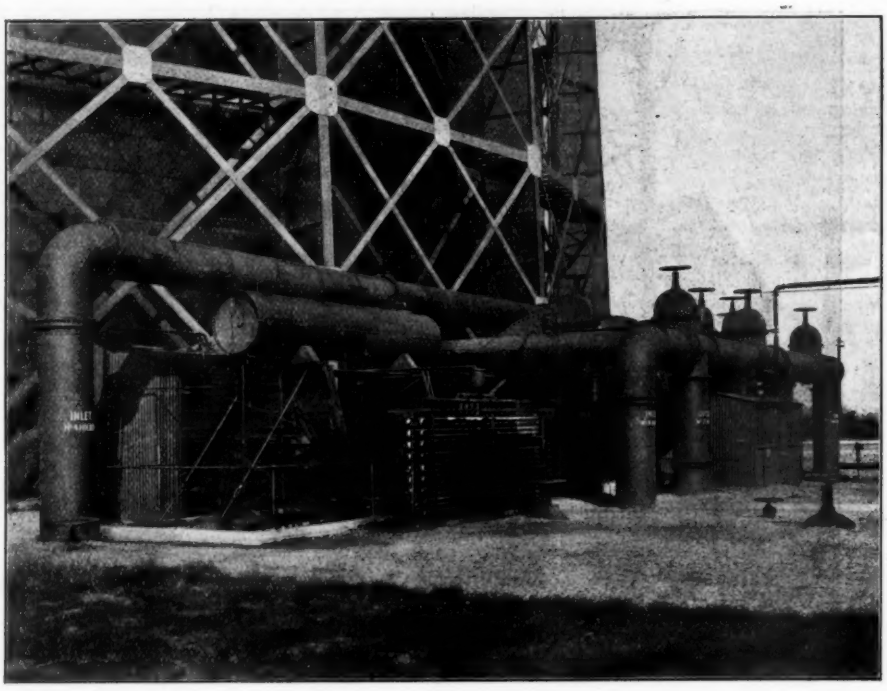
He had the pleasure to make an announcement which would be of some little interest to their consumers. From the beginning of the current quarter in the case of their ordinary consumers, and from the approaching reading of the meters in the case of their automatic consumers, the price of gas would be reduced throughout the whole of their area by a halfpenny per therm. This followed upon a similar reduction which they made as recently as April last; and the two reductions, on the basis of their present consumption, would save their customers something approaching £50,000 a year.

Referring to the guests, Mr. Lapthorn said that the Lord Mayor had done them the honour of coming there that day to start the new installation; and they would like him to accept from them a silver inkstand as a souvenir of the occasion. Continuing, he expressed pleasure at being able to welcome Mr. J. F. Ronca, who held the responsible position of Director of Gas Administration. They had also with them their friend Mr. Savins, who had the confidence of his fellow workers in the Company to the extent that they had elected him as their representative on the Whitley Council of the Southern District Gas Undertakings.

The Lord Mayor, having expressed his gratitude for the very handsome memento, proceeded to thank the Directors, on behalf of himself and his colleagues, for the hospitable manner in which they had been treated. They were very happy to be there, for they thought it was a good thing for public men to have the opportunity of seeing over such works. In going round the works they had seen that the Company could make and repair anything from a gas meter to a locomotive. They had been provided with their lunch in a splendid dining hall which had been erected for the employees; but every workshop they had seen was fit to be used as a dining hall as well, and for that they heartily congratulated the Company. Notwithstanding all the improvements they had made, and all the money they had spent in perfecting their works and in looking after the comfort



THE NEW WATER GAS SET.



THE NEW GAS DRYING PLANT.

of their employees, the Company were able to-day to say that their gas, especially when the improvement in the quality was considered, was as cheap as, if not cheaper than, in pre-war times, and for that he congratulated them also. They heard sometimes that gas supply was a monopoly; but they were all satisfied that it was not so regarded by the Portsmouth Company, neither was it abused; and they hoped that the Company would go on and prosper, and that they would continue to produce gas at the lowest possible price. He also thanked Mr. Carmichael for having made their tour so interesting.

THE PROUD POSITION OF GAS.

Mr. J. F. RONCA also responded, and said Portsmouth was to be congratulated upon its gas undertaking. It was part of his business to see a good many gas-works in the course of a year, and he was bound to say that he admired very much the works he had seen that day. It was very clear that even thirty or forty years ago the Company was in the hands of men who had foresight, and who had provided a very good lay-out. At the present time, everybody looked upon fuel as a very important matter, and they had to remember that it was largely to cheap fuel that England owed her position to-day. If they could not get cheap fuel, they had to find a more efficient means of using it, and that was a burning problem at the present time. As they knew, there was at that moment sitting in London an International Fuel Conference, and many of the papers that were being read were of the greatest importance; but after all, they were only papers, and it brought a man back to realities to come down to a place like Portsmouth and see what was actually being done for fuel economy and for fuel efficiency. He was not going to quote statistics, but he wished to refer to one thing that had been said, and that was that the price of gas to-day was something like the pre-war price. He asked them to cast their minds over the other fuels that obtained to-day, and see how many of them they could get at pre-war price; and when they had done that, he asked them to remember that gas was the fuel they could use with not only the greatest convenience and ease, but the greatest efficiency. All big industrial works wanting to use coal—the fundamental fuel of this country—started by gasifying it, simply because in the gasified state it could be used with greater efficiency, and over its use a greater and more effective control could be exercised.

The LORD MAYOR then proposed the toast of "Our Hosts," coupling with it the name of the Chairman, Mr. Lapthorn, who, he said, had been connected with the Company for over twenty years. It was very interesting to learn that during that period the output of

METER REPAIR SHOP, SHOWING AIR DUCTS OVER THE BENCHES.

the Company had nearly doubled; and he was sure that Mr. Lapthorn and his colleagues would not remain content with that, but would continue to go forward.

The CHAIRMAN's brief reply brought the proceedings to a close.

THE HILSEA EXTENSIONS AND THE RUDMORE STATION.

The new C.W.G. installation has been erected alongside the previously existing water gas plant, but in an entirely new building, which is of the steel-framed brick-panelled type, designed to harmonize with the vertical retort house. The lay-out of the new house provides space for two sets of plant, only one of which is at present installed. Inside the shell of the building is erected the operating floor, supported partly on the plant itself, partly on cast-iron columns; and a portion of this floor is roofed by steel coke bunkers, to which a supply of coke can be regularly brought by a telpher transporter, the track of which has been extended for this purpose. The building is very roomy, and particular attention has been paid to lighting and ventilation. At the south side of the building, and on the same level as the operating floor, is situated the blower house, containing two turbo-blower sets, each comprising Sturtevant fan driven through gearing by 55 H.P. de Laval turbine. Provision has been made in the construction of the blower house floor for the erection of two further sets at a later date; and the remainder of this room has been arranged as mess room and lavatory for the gas plant staff. Access is provided by a gangway to the operating floor of the older gas plant, while the space beneath the blower room has been utilized as a store for accommodating fire-brick linings and other spare parts required for the maintenance of the plant.

The generator is 11 ft. diameter by 17 ft. 6 in. high. Coke is fed by means of a hydraulic charging machine supplied from the overhead hoppers, in its passage from which the coke traverses a bar screen, which transfers the breeze and dust by means of a steel chute into a telpher skip at ground level. The advantage of the hydraulic charging machine is an increased output when compared with the older type of hand-charged generator, as in the new plant coke can be fed while the plant is in operation. A new atmospheric condenser has been erected between the old and new water gas houses, and comprises in all 3400 ft. of 12-in. cast-iron pipe, arranged in ten sections, and provided with valves, by-pass, &c. It is connected by suitable mains with condensers of the older plant, so that one or both condensing installations may be used either in parallel or in series. From here the cooled gas passes into the relief gasholder. The plant is complete with waste-heat boiler; and the stack is fitted with a "Centriflovane" grit catcher.

OTHER RECENT EXTENSIONS.

The extension of plant at Hilsea Gas-Works since June, 1926, has not been entirely confined to the new water gas installation. The telpher plant has been extended, both for the latter and to provide additional storage in the coke yard. The total extensions represent about 400 ft. of track.

In the governor house alongside the offices, two new turbo-boosters have been erected, each of 750,000 c.ft. per hour capacity, and each driven at 2160 R.P.M. by a 55 H.P. de Laval turbine. These boosters have been found necessary for the purpose of increasing the supply to the city, as well as for augmenting the pressure in the outlying country districts.

A new process of gas drying has also been introduced; the whole of the gas leaving the station meters and entering the gasholders being passed through a rotary washer, and there treated with a concentrated solution of calcium chloride. The gasholders have been provided with a film of oil.

Additional water softening plant has been erected, including a quartz filter and steel storage tank of 150,000 gallons capacity.

THE DISTRIBUTION DEPARTMENT.

For many years a gasholder and governor house have been in operation at Rudmore, and here have also been situated the Company's workshops for the testing and repair of meters, stoves, and other appliances. Prior to 1926 the gasfitting and lighting department had its headquarters in Park Road. It was then found, however, that the rapid growth of the Company's business, together with the disadvantage of maintaining separate stores and the transporting of meters and other appliances through the town, made it imperative that other accommodation should be found. The existing buildings at Rudmore were therefore considerably enlarged by the addition of a gasfitters' workshop, machine shop, paint shop, commodious stores, offices, &c., as well as the extension of the stove and meter shops.

The Fittings Department is responsible for the equipment of internal supply pipes and all gas-consuming appliances on consumers' premises, and for seeing that these are maintained in a condition to give an efficient service. The Inspectors allocate a full day's work to each workman, previous to which the necessary materials for the job have been estimated, and the Stores Department advised, so that they can have the articles placed in readiness for the fitter, or for their dispatch by motor transport. The district work is controlled from this centre; each district being in charge of an Inspector, who is responsible for all work carried out in his particular area. In order to increase the efficiency of the service to consumers in outlying districts, branch offices and showrooms have been opened at North End, Waterlooville, Havant, and Emsworth. In the Fittings Department between 1800 and 2000 jobs are attended to weekly.

No fewer than 7500 meters of all sizes are dealt with annually through the cleaning, testing, repairing, and paint-spraying shops.

An average of 200 cookers, heaters, and other appliances is received weekly and dealt with in due course in the renovating shops; and in addition to the above, the number of fires, radiators, and appliances cleaned, adjusted, and put in working order on consumers' premises is approximately 40,000 per annum (which is included in the above-mentioned total of jobs handled by the Fittings Department).

The light stores are accommodated in a building adjoining the fitters' shop, and are divided into three sections—namely, meters, stoves, and district fittings. Some idea of the vastness of the stock of parts can be arrived at when it is stated that the Company is responsible for the upkeep of over 200 different types of cooking and heating stoves, the various parts of which are known to exceed 2000; and the total cookers, fires, radiators, boilers, &c., on the district is estimated to exceed 113,000. The heavy stores room is a separate building facing the gasfitters' shop, and contains at each end a loading dock for motor lorries, in conjunction with which a petrol storage tank and petrol delivery apparatus have been installed.

Above the stores room is the employees' mess room, where suitable apparatus for the cooking of meals is provided.

GENERAL INFORMATION.

The area of supply of the Company was considerably extended by the statutory powers obtained in 1926 and 1927, when Government sanction was obtained for the acquisition of the Havant and the Emsworth Gas Companies. The manufacturing stations of these undertakings have been dismantled; and the whole of their consumers, as well as many hundreds of new consumers in their districts, are now obtaining a satisfactory supply of gas direct from Hilsea Works. The following statistics are of interest:

Area of district	103 sq. miles
Number of stoves on hire	71,316
,, ,, ordinary consumers	26,470
,, ,, automatic consumers	35,160
Gas sold, 1927	2,655,176,000 c.ft. 11,950,000 therms
Price of gas within the City, ordinary	7d. per therm
,, ,, ,, ,, ,, automatic (meter only)	8d. per therm

with the following discounts:

For Lighting, Cooking, Heating, and other Domestic Purposes.

5 p.c. on excess beyond 450 and not exceeding 2250 therms
7½ ,, ,, ,, ,, 2250 ,, ,, ,, 4500 ,,
10 ,, for ,, ,, 4500 therms.

For Manufacturing and Industrial Purposes (registered by separate meter).

10 p.c. on excess beyond 450 and not exceeding 2250 therms
12½ ,, ,, ,, ,, 2250 ,, ,, ,, 4500 ,,
15 ,, ,, ,, ,, 4500 therms.

For Engine Supplies (registered by separate meter).

15 p.c. irrespective of quantity consumed.

Flicker of Luminous Flames.—In an American Chemical Society paper, Messrs. Chamberlin and Rose state that the vibratory motion of luminous flames has been studied by photographic method. The rate of vibration, speed of flame, movement, and amplitude of vibration have been determined for various gases under different conditions. The data show that the upper portion of the luminous zone rises to a maximum height ten times per second. This rate of vibration is not greatly affected by change in conditions. The lower portion of the flame has a continuous existence, but periodically gives off another flame which rises above the main flame during its short period of existence.

Eastern Counties Gas Managers' Association.—The autumn meeting of the Association will be held at the Holborn Restaurant, W.C. 1, on Thursday, Oct. 18, when the President, Mr. J. B. Hansford, of Bedford, will take the chair at 2.15. Following the presentation to Mr. C. E. Smith, of Retford, of a Certificate gained in the recent Higher-Grade Examination in Gas Engineering, Dr. J. G. Stewart will read a paper on "The Control of Calorific Value." A paper on "Technical Control in the Retort House" will then be read by Mr. Ronald B. Glover. The President-Elect of the Association is Mr. H. C. Smith, of Tottenham, who will take office on Jan. 1 next.

World Power Conference.

Fuel Conference.

London, Sept. 24 to Oct. 6, 1928.

[For papers and discussions on the Carbonizing Industries, and papers in the Fuel Utilization Section, see "JOURNAL" for Sept. 26 and Oct. 3.]

General Report on Section B: Sampling and Testing of Solid Fuels.

This Section met under the Chairmanship of Dr. F. S. SINNATT (Fuel Research Board) on Tuesday, Sept. 25, when the following General Report was presented by Dr. A. PARKER.

The following papers have been communicated for consideration by this section of the conference:

Sampling and Testing of Coal (Austria).

A Practical Comparative Basis for the Calorific Value of Coal (Poland), by Stanislaw Felsz.

Determination of Volatile Matter in Coal by Low-Temperature Methods (Czechoslovakia), by R. Vondrácek.

The Hygroscopic Qualities of Coal (Czechoslovakia), by R. Vondrácek.

The Use of Gross and Net Calorific Values for the Purpose of Guarantee Tests (Germany), by N. F. Nissen.

The first paper, presented under the auspices of the Gesellschaft für Wärmewirtschaft, Austria, gives a general account of those methods recommended by this authority for general adoption in Austria in the sampling and examination of coal and coke.

The communications, prepared by Mr. R. Vondrácek, and presented by the Czechoslovakian National Committee, describe a low-temperature method for the determination of volatile matter in coal, and an investigation of the hygroscopic qualities of coal under different conditions.

The paper by Mr. Stanislaw Felsz, of Poland, introduces the conception of a standard coal as regards calorific value, with the object of simplifying the comparison of coals used on the Polish railways.

The communication by Mr. N. F. Nissen, for the Vereinigung der Deutschen Dampfkessel-und-Apparate-Industrie, Düsseldorf, und Allgemeiner Verband der Deutschen Dampfkessel-Ueberwachungs-Vereine, München, has also been included in this section, since it discusses the use of gross and net calorific values of solid fuels for guarantee tests, and thus deals with the interpretation of results dependent on determination of calorific values.

During recent years considerable attention has been directed towards the standardization of methods of sampling and examination of solid fuels for commercial purposes, and, in some cases, authorities of recognized standing have already prepared definite specifications which will, presumably, be reviewed periodically, and, if necessary, modified.

For the purposes of many special investigations and researches standardized analytical methods would be unsuitable, and, further, their too extended use might conceivably operate against progress; but even in pioneer work, difficulty is frequently experienced in attempts to compare the results of different investigators, owing to the wide divergencies in analytical methods adopted.

There is no doubt, however, that for general commercial and technical requirements, the adoption of standard methods would prove distinctly advantageous, especially if the particular methods laid down received international approval. It is believed that this session of the conference can serve a useful purpose, provided the questions considered and discussed are limited to methods which might be employed in connection with technical tests as distinct from special investigations. This necessarily means that only those methods of sampling, testing, and analysis should be brought forward which could be completed in reasonable time, compatible with required accuracy and with reasonable facilities and apparatus.

It is too much to hope that in one session it will be possible to arrive at specifications which would receive universal approval, but the discussion should constitute a useful preliminary towards the formulation of international standard methods. This conference will have merited its organization if it succeeds in promoting closer co-operation between the recognized authoritative bodies already studying the subject in different countries.

The complete process of evaluation of a solid fuel may be divided into two main sections—sampling, and examination of the samples—each of which may be further sub-divided as indicated by the following arrangement:

I.—Sampling.

- (*a*) Selection of large sample representative of the consignment.
- (*b*) Preparation from the large sample of laboratory or test samples.

II.—Examination of samples.

- (*a*) Proximate analysis, including moisture, volatile matter, fixed carbon, and ash.
- (*b*) Ultimate analysis, including carbon, hydrogen, sulphur, nitrogen, oxygen, and ash.
- (*c*) Calorific values, gross and net.
- (*d*) Tests not so frequently required—*e.g.*, specific gravity and caking index of coal, true and apparent specific gravities and porosity of coke, reactivities and ignition temperatures, melting-points of ash, composition of ash, &c.
- (*e*) Special tests for particular purposes—*e.g.*, carbonization assay of coal, including examination of products.

Sampling.

Although it may not be possible to specify detailed instructions which could be followed in all circumstances in taking samples representative of a consignment of solid fuel, the procedure and precautions to be observed, as outlined in the paper by the Gesellschaft für Wärmewirtschaft, of Vienna, will doubtless meet with general approval. In fact, the general procedure is already adopted by a large number of fuel technicians.

Proximate Analysis.

The most usual method of ascertaining the moisture content of solid fuels includes the preliminary determination, with comparatively wet fuels, of the loss in weight on drying a large sample in air at a temperature rather higher than that of the surrounding atmosphere. The air-dried sample is then estimated

for moisture by determining the loss in weight of a small sample when heated in an oven at about 105° C. for a specified time. Certain types of coal, however, when heated to 105° C. in air, undergo oxidation, and errors result. To obviate this oxidation, many methods have been devised, both direct and indirect; and the method recommended in the first paper is that in which a sample of coal (usually 30 to 50 grammes) is placed in a flask with 200 cc. xylol and distilled; the water carried over with the xylol and condensed being accurately measured. Methods employed by other authorities to prevent oxidation include that of drying the sample at 105° C. in an oven supplied with an inert gas free from oxygen.

The determination of volatile matter is carried out in Austria by a method almost identical with that prescribed in America. The sample is heated in a platinum crucible for seven minutes at 900° to 950° C. It is well known that with certain fuels—*e.g.*, high-temperature coke—this method does not give reliable results, and requires modification to prevent a variable loss due to combustion. One modification is that used in Austria for brown coals, which are heated and cooled in a Rose crucible supplied with inert gas.

Ultimate Analysis.

Carbon and hydrogen are almost universally determined by combustion in oxygen, according to the recognized procedure for the determination of these elements in organic compounds. Several methods have at various times been suggested for the estimation of the elements by examination, either gravimetrically or volumetrically, of the gas remaining after combustion of the sample with oxygen in a calorimetric bomb; but, in general, these methods either do not reduce the work involved or are less accurate.

The results of systematic investigations of the different forms of sulphur in coal have been published during recent years, but usually it is sufficient to ascertain the total sulphur content of a fuel, or, at most, the combustible sulphur and the sulphur in the ash. For total sulphur, the Eschka method is perhaps most employed, but other methods, of which combustion with sodium peroxide might be mentioned, are extensively used. In Austria, the total sulphur is obtained by addition of the sulphur gasified in oxygen in a combustion tube and the sulphur content of the ash of the sample. Sulphur might also be conveniently determined in conjunction with the calorific value in a bomb calorimeter.

Nitrogen is usually determined by various modifications of the Kjeldahl method. Several recent investigations have led to the conclusion that the Kjeldahl process probably leads to results which are too low. For this reason, some authorities, including the Gesellschaft für Wärmewirtschaft, of Vienna, have adopted modified forms of the Dumas method of combustion with copper oxide. The great disadvantage of the Dumas method, however, is that it is not nearly so convenient, and requires much more skill and attention than the Kjeldahl process.

The determination of the amount of ash in a solid fuel by the usual method, though simple, is not altogether satisfactory, in that the ash is obtained in a different state of oxidation from that in the original fuel. This change in state of oxidation of the ash constituents has an important influence on the difference figure which represents the quantity of oxygen in the fuel. A satisfactory direct method of estimating oxygen is urgently required, for there is no doubt that reliable figures for this element would aid in the elucidation of several problems of fuel technology.

Calorific Values.

The well-known method of determination of the gross calorific value of a solid fuel by combustion in a bomb of the Berthelot-Mahler type is almost a universal standard; but there appears to be a lack of uniformity in the data employed in making the necessary deduction to obtain the net value. In the first place, the precise meaning of net value requires rigid definition, with special reference to the amount of heat to be deducted from the gross value for each unit weight of water in the products of combustion. The amount of the deduction is dependent on the final temperature to which it is assumed the water vapour is cooled without condensation.

Other Tests.

The caking index of coal is generally measured by a modification of the Campredon test, and represents the maximum number of parts of sand which may be mixed with one part by weight of coal to produce a coherent coke when heated to about 950° C. Objections to this method have been raised on the grounds that sand is an inert material very different from the substances ordinarily employed in carbonization, and that it is difficult to ensure different supplies of sand of the same quality. Other methods suggested, however, do not appear to possess any marked advantages over the modified Campredon test.

The apparent specific gravity of coke is obtained from the weights and volumes of typical pieces. The volume may be obtained by several methods, two of which are mentioned in the first paper. Reference might also be made to the method of weighing pieces of coke in air and in mercury. Tests for apparent gravity of coke, however, would seem to require systematic investigation before a satisfactory standard could be recommended.

Further study of the factors associated with the properties of solid fuels as regards reactivities towards steam and carbon dioxide and as regards ignition temperature is necessary before any approach to uniformity in evaluating these properties, now assuming so much importance, can be expected.

Special Tests.

The determination of the volatile matter removed from coal under low-temperature conditions is discussed in the first communication by R. Vondrácek, and a test is described. The sample of coal, 1·2 to 2 grammes, is placed in a hard glass tube heated to 444° C. in the vapour of boiling sulphur. Some interesting results and possible deductions are given.

The factors which account for the difficulties in attempts to determine the hygroscopic powers of coals have been investigated by Mr. R. Vondrácek, and the results are described in his second paper. The main difficulty results from the fact that the absorption of moisture by coal is not strictly a reversible process. A test is suggested for obtaining comparative values of hygroscopicity.

The carbonization assay of small samples of coal with the object of evaluating different coals for commercial carbonization processes is rapidly becoming of great importance. It is doubtful, however, whether the time is yet ripe for the establishment of standard methods of assay. In the first place, it is not easy in a laboratory apparatus to obtain results from which the yields of products in a particular large-scale process could be predicted with sufficient accuracy. Secondly, many technical processes are widely different from one another.

Evaluation from Calorific Values.

Two papers discuss the methods of evaluation of solid fuels from the results of determination of calorific values. Mr. Stanislaw Felsz suggests the conception of a hypothetical standard coal with a gross calorific value of 6320 cals. per gramme (11,376 B.Th.U. per lb.) in the evaluation of coals for use in raising steam for the railways of Poland. A calorific value of 6320 cals. approximates to the average quality of the coal employed, and simplifies calculation if the total heat of steam be taken as 632 cals. per gramme and the heat equivalent of one-horse-power-hour be taken as 632 cals. The evaporation per unit weight of standard coal is then exactly one-tenth of the percentage efficiency of the steam raising unit.

According to the specification for conducting guarantee tests of steam-raising plants in Germany, during a period of two years efficiencies have been reported on the basis of both the gross and the net calorific values of the fuel consumed. The gross calorific value assumed that the initial and final temperatures of the fuel and products of combustion were 0° C.; the net value assumed that the dry gases were cooled to 0° C., but that the water vapour was cooled only to dew-point. The experience gained has led to the conclusion that efficiencies based on gross value are not satisfactory, and that net values only are required. Calculations are made and curves are given to show that the efficiency of a particular installation, consuming the same fuel throughout, may change considerably if derived from the gross value, with variation in the moisture content of the fuel, but that the efficiency derived from the net value is liable to only small variation.

Discussion.

Dr. Parker, opening the discussion, suggested that, if the various authoritative bodies representing the different nations were to get together, probably some satisfactory sample standard test could be universally accepted. In the same way, he believed that a test for the determination of volatile matter could easily be decided upon as satisfactory for universal adoption, notwithstanding the differences of opinion that now existed upon certain details. As regards calorific value, the method of determining the gross value was fairly well standardized in the bomb calorimeter; but with regard to the net value, different authorities made different deductions for each unit weight of water content. This was a point which required study by the authoritative national bodies; and again he did not think there should be a great deal of difficulty in arriving at some agreement. An important point brought forward in the papers was whether the gross or the net calorific value should be taken for the purpose of guarantee tests. This was a problem which could not easily be settled, and required further consideration. For steam raising plant it seemed that, from the work done in Germany, the net value was the more suitable, but the net value could not be used for all purposes. For example, in the carbonizing industries a certain weight of coal, having a definite gross calorific value, was carbonized, and the heat value of the resulting products was determined. In a case like that it was absolutely essential to use the gross value as a basis; the net value would be practically meaningless, though

in the case of net value for guarantee tests it would have to be limited to tests with particular types of plant and apparatus. Finally, Dr. Parker strongly urged the need for co-operation between the different national committees with a view to standardization.

Work of the "B.E.S.A."

Mr. C. E. Le Maistre (Secretary of the "B.E.S.A.") referred to the work that was being done by the "B.E.S.A." in regard to the classification of coals and the national survey of the coal resources of this country, and said that it was at the instigation of the Fuel Research Board that the "B.E.S.A." some nine or ten months ago got into touch with the coal owners, the scientific people, and the commercial people. A report by the Fuel Research Board upon the coal resources of the country was adopted as a basis for further investigation and as a starting point for a much more detailed study of the whole problem. That conference showed very clearly indeed that what was required in this country was some commercial agreement, in order that a more scientific selling of coal might be brought about. In other words, while the conference fully realized the scientific interest of the matter, it also realized that industrial standardization was only about 15 p.ct., and that 85 p.ct. was human. It was not the least bit of good setting fine scientific standards and then waiting for the commercial people to adopt them. This would not do the country any good; and the consequence was that, while the scientific side was being fully borne in mind, the "B.E.S.A." had two Sub-Committees, one on sampling and one on analysis—the former having five panels dealing with moisture, volatiles, ash, sulphur, and calorific value. The whole object was to bring about some industrial agreement on these points, in order that collective effort might be made for the good of the industry. The ultimate aim was to bring about international action; and, indeed, a liaison Committee had been formed which was keeping in touch with foreign countries. At least two or three other countries were alive to the importance of this subject, and were most willing to come together to help the British Committee in the problems facing them. Moreover, liaison committees had been formed in Cardiff, Newcastle, Glasgow, Sheffield, and Manchester; so that the country was well organized both on the principles as well as on the details. There had been an attempt to establish a federation of the national standardizing bodies; but for reasons which he could not enter into, that had not entirely succeeded. Great Britain and one other country did not feel that under the conditions and with the proposals put forward they could heartily support the organization proposed. Great Britain, however, had done more than any other country in the matter of international co-ordination; and it seemed to him that the country which had done so much already might be the country to be asked to take the steps to go forward to a greater extent. It was a matter, however, which closely concerned the commercial people; and in no country should the pure technicians have too much charge of the work. Otherwise there was a danger of proposals being put forward which, though technically would be perfectly just, would not recommend themselves to the commercial minds wanting something simple which would enable a comparison of tenders to be made and would let the buyer know what he was getting.

Dr. E. W. Smith (Technical Secretary to the Conference) said that the World Power Conference itself had no intention of carrying out this standardization work, but the Executive Committee felt it necessary to keep the door completely open to the encouragement of co-operation. He paid a high tribute to the work of the "B.E.S.A." from personal knowledge of it; but they must remember that all the wisdom did not lie in the "B.E.S.A." or in Great Britain; and from the purely psychological point of view, whatever the actual facts might be, it was fundamentally necessary to realize that there might be some value in the other countries.

Oxidation of Coal.

Mr. G. W. Himus (Imperial College of Science) observed that at the Imperial College of Science they claimed to have got over the difficulty of oxidation of the coal during drying by the use of a steam heated vacuum oven; and from the technical point of view he preferred this to the xylol method, because, though the latter gave accurate results, the apparatus took up valuable bench space and was not useful for any other purpose, whereas the vacuum oven could be used for many other purposes. The method of determining volatile content adopted at the Imperial College was to heat the coal in a small silica tube, which was enclosed in a larger silica tube, under such conditions that the gas evolved from the coal forced water out of a bottle into a second bottle; the water in the second bottle acting as a seal. Thus the coal was heated and cooled in contact with its own gas, and any risk of oxidation was avoided. The consistency of the results obtained was in the neighbourhood of 0·1 to 0·2 p.ct.

Determination of Sulphur.

Prof. Vondracek (Czechoslovakia), referring to the paper presented under the auspices of the Gesellschaft für Wärmewirtschaft, said this did not give the details of the determination of the calorific value; and further information on that point would be useful. He was optimistic enough to hope, however, that they would soon come to an international standardization of methods. His own country was rather rich in coals and lignites, and was ready to take part in this work. The proposals in the paper to which he had referred only described the determination of the combustible sulphur and the ash sulphur, and not that of the total sulphur content. There was no doubt that the combustible sulphur had a most injurious effect while burning the coal in furnaces; but the conditions in which the coal was burned in a crucible in a laboratory and under actual combustion conditions in the furnaces were very different, and the proportion of sulphur going into the gases would not be the same in each case. For this reason he preferred the determination of the total sulphur content in the coal, as this result indicated the quality of the coal in a more definite manner.

Truck Sampling.

Dr. H. B. Cronshaw described a method of truck sampling which he called the pipe method. This, he said, was very definite and fairly rapid, and had been used in the United States. By this method a 3-inch pipe 4 ft. long was driven into a truck of coal at suitably chosen points, and the pipe contents were heaped together in bulk in the usual manner. For making the coking test for industrial purposes, he had replaced a fireclay crucible by silica beakers, owing to the variations in the fireclay crucibles when subjected to heat due to the absorption of moisture. Moreover, the heat transmission with the silica crucibles was much more rapid. With the use of the silica vessel, however, there was the danger of loss owing to the sudden evolution of gas; and in order to obviate this, he had departed from the usual practice of inserting the crucibles in an electrically heated ash furnace in the ordinary way, and reduced the temperature at the start to 600°, increasing it gradually to 800° for half-an-hour. The softening temperature of coal was a useful thing to know; and he suggested that it might be done by powdering coal and then moulding it into pyramid formation, and raising the temperature in an inert atmosphere, noting the temperature at which the cone bent.

Ultimate Analysis.

Dr. F. D. Tideswell (Safety in Mines Laboratory, Sheffield) said it was important to stress the value of the ultimate analysis of coal, because it gave a true guide to the nature of a coal and, indeed, to its utilization—a point which was not generally realized, and one which would be of greater importance in the future in the technical classification of coal. It had been urged that the determination of the oxygen content was urgently required, but he had never yet found any great value in it. The main error in oxygen determination was the error belonging to the ash; and when a determination of oxygen had been made directly, it would still be essential to apply a correction for the mineral matter present—a correction which had been worked out in his laboratory. As regards sampling, he had found a difficulty when the sample was taken from a composite source. In that case there was the difficulty of obtaining a satisfactory ash value (say) for a mixture of a coal and a shale; and he wondered whether the difficulty was universal or whether he had struck a particularly bad example.

Mr. A. Worsley remarked that any question of standardization of form of analysis must secure the good wishes of the commercial world. Where dry coals and hydrous coals were lumped together, it would pass the wit of any chemist to devise any method of analysis which would be acceptable both to the producers of dry coal and the producers of hydrous coal. At the present time the method used by the sellers of coal—it could hardly be called analysis—gave a very low value to lignites on account of their high moisture content; and difficulties arose in this connection for climatic reasons. For instance, in a very dry climate like that of Central Spain in summer time, the coal, when it was brought to the surface, was high in water and had a low carbon content, but under the influence of the dry and hot winds on the surface it decrepitated very rapidly, and by the time it reached the consumer it was very different from the condition in which it was first analyzed. It had lost a lot of water and gained in carbon content; and this was one of the reasons why it seemed to him a little difficult to arrive at some standard method which would be acceptable to the producers of both classes of coal, though he hoped it would be possible.

A Resolution Regarding Calorific Value.

Herr Zur Nedden (Berlin) submitted the following resolution in regard to calorific value:

> Whereas there is no uniformity in the practical application of the gross or net calorific value of fuel—solid, liquid, or gaseous—either within the several countries or as between producers and consumers of the fuel or internationally; and whereas such uniformity, as convincingly pointed out in paper G 3 and other papers, is considered to be most desirable for correctly comparing efficiencies and fuel costs. Be it resolved that the International Executive Council of the World Power Conference shall exert every effort to ensure international agreement on these matters.

Mr. C. E. Le Maistre (Secretary of the "B.E.S.A.") seconded the resolution, and offered to submit an interim report upon the work done by the "B.E.S.A." in this respect as a basis of future work.

Dr. R. Lessing spoke in support of the resolution.

The resolution was put to the meeting and carried.

Mr. W. M. Selvey said that whatever was decided by way of standardization, it must be remembered that there were those who had to carry out the decision, but it was impossible to carry out in ordinary commercial work tests with that order of accuracy which usually arose from academic discussion. As a practical man he heartily detested any idea of going back to the net calorific value, because in one case under the old method of the Institution of Civil Engineers he calculated it was capable of 32 different interpretations. What he found that industry and buyers wanted was a reasonable certainty—they were not really concerned with absolute accuracy—of consistency in such a manner that, if at some future date improvements were made, the method could be re-interpreted. As to sampling, he was satisfied after twenty years' experience that there was no method of shovel sampling which could ever be made scientific, and that there was no scientific method of sampling which could ever be made commercial. To those interested in the subject, he recommended a perusal of the paper by Mr. Miles before the Incorporated Municipal Electrical Association, at Buxton, two years ago. Mr. Le Maistre had indicated the very important work which was being done; and he hoped that they would arrive at some consistent, if not necessarily absolutely accurate, method in relation to moisture, sulphur, and ash.

The session closed with a cordial vote of thanks to the Chairman and Vice-Chairman (Dr. R. Lessing).

Discussion on Fuel Utilization: Section K.

This Section met under the Chairmanship of Mr. GEORGE A. ORROCK, on Friday, Sept. 28, when a General Report was presented by Mr. Roger T. Smith (see "JOURNAL" for Oct. 3, p 37.)

Sir ROBERT HADFIELD, F.R.S., said that not long ago he was President of the Society of British Gas Industries, and he devoted a portion of his Presidential Address to the study of fuel and gas technics. At that time the Fuel Research Board had only just been established, and there was not very much information available with regard to these particular subjects. That Presidential Address, which consisted of some 80 or 90 pages, was distributed to the extent of 2000 copies, and he believed it had helped a large number of young men, because it contained the results of a great deal of experience in his own works during the war, where enormous quantities of gas and electricity were consumed. Referring to the paper by himself and Mr. Sargant, Sir Robert said that in his works they had been actively engaged in trying to meet the wants of engineers by giving them alloys which would show very high resistance to heat effects.

Mr. R. J. SARGANT remarked that a paper of outstanding interest in furnace work was the one which gave a comprehensive account of the state of progress—and the marked degree of progress—in the use of industrial gas in the United States. It was also to be noted from the statistics supplied by the largest gas undertakings in Great Britain that the proportion of industrial gas used for industrial heating, expressed as a proportion of the total gas used for all purposes, was as near as possible 10 p.ct. The further outstanding point was that the increase in the rate of use each year was only of the order of 1 p.ct. The cost of producer gas in iron and steel works, of which he could speak with some familiarity, might be of the order of 1·3d. to 2d. per therm. In a city in the industrial north where coke oven gas was readily available, the cost per therm supplied to the furnace—and he wished to lay stress on that point—was within measurable distance of the requirements of iron and steel works, taking into account that very important factor, adaptability. As regards electric heating, this had been considered to displace oil in one of the Hadfield shops for the heating of springs. The actual cost of the tempering and hardening of springs with the oil furnace was 1s. 8d. and 7s. 6d. per ton respectively, whereas with electric heating under continuous load the best costs were 8s. per ton for the tempering and 16s. per ton for hardening; and nothing had been found in ancillary savings to bridge that gap between the costs.

ELECTROLYTIC HYDROGEN.

Mr. L. H. SENSICLE (Newcastle Gas Company), speaking with regard to the chemical use of hydrogen, pointed out that Mr. Stuart had made a rather suggestive remark concerning the utilization of electric supply in filling up the seasonal valleys of the load curve by an electrolytic load. The suggestion was that electricity should be used for electrolyzing water off the peak load. Mr. Stuart, however, had failed to stress a very important point by omitting the chemical aspect. He seemed to emphasize the energy-conserving nature of the process; but when it was examined closely from that point of view, it was not quite so good as it seemed. The electrolysis of water required an amount of energy which was exactly equal to that energy which was liberated when the oxygen and hydrogen were recombined. If water was electrolyzed, and converted into hydrogen and oxygen, which were put into gasholders, it seemed that it might be possible—so to speak—to store electricity in gasholders; but it was impossible to get more than 30 p.ct. of that energy back as electricity. There was much to be said for the electrolytic process, because the hydrogen could be used—and it was suggested that it could be got for 5 cents per 1000 c.ft.—for chemical processes such as the hydrogenation of oils, for synthetic ammonia production, &c. It did not seem that the oxygen was going to be of much value if used for boiler firing, because the efficiencies obtained in boiler firing were high at present, and the losses in the generation of electricity were mainly in the prime mover, and not in the generation of steam.

LOW-GRADE GAS.

Mr. GEORGE HELPS (Nuneaton) said that Sir Robert Hadfield had reminded them of the time, some few years ago, when he was President of the Society of British Gas Industries. At that time Sir Robert was particularly interested in the use of town or high-grade gas for furnaces; and as he had mentioned in that presidential address to which he had referred some of the work that was being done at Nuneaton, Sir Robert would no doubt be interested to learn that since then the quality of gas had been reduced at Nuneaton gas-works to about 200 B.Th.U. He (Mr. Helps) had not much experience of the firing of steel furnaces with gas of either 500 or 200 B.Th.U.; but from general principles he took it that, if the flame temperature of a 200 B.Th.U. gas was within very little of that of a 500 B.Th.U. gas, there could be no question of the practicability of applying it. At the present time gas was being produced in Nuneaton from local coal costing less than £1 per ton, and it was possible to supply that gas to a local steel works at 1d. per therm profitably, including interest and depreciation charges. He had been at gas-making in this country and abroad for 45 years. He had used it for all manner of purposes, and had found that the lower the quality, the greater the facility of use. Probably that would not be accepted from him; but Dr. W. B. Davidson, who had investigated the matter, would say that the difference in the flame temperature of a 500 and a 200 B.Th.U. gas was negligible. That, he was sure, would be particularly interesting to Sir Robert Hadfield, because during the war there were big users of gas in Sheffield who said that, if the quality dropped from about 550 to 540, they could not work at all. He believed that flame temperature depended upon rapidity of combustion; and there was some inherent factor probably concerned with 200 B.Th.U. gas—or gas of a low quality—which permitted the development of more B.Th.U. on a given area than was possible with a richer gas.

GAS *v.* ELECTRICITY FOR INDUSTRIAL WORK.

Dr. C. M. WALTER (Birmingham Gas Department) remarked that as one who had been interested for a number of years in the application of town gas he would like to say something on this question as compared with the use of electricity. Incidentally, he agreed with Mr. Sargant as to the great importance of arriving at some definite conclusion as to what was meant by furnace efficiency. Personally he was in full agreement with the definition of efficiency used by Sir Robert Hadfield in his paper—viz., that in industrial operations furnace efficiency was the ratio of the sensible heat *plus* the latent heat, to the load, divided by the total heat in B.Th.U. supplied. This, however, did not take into account thermal gradients and the transfer of heat through the furnace walls. That really concerned the furnace maker and not the user; and in quoting figures of efficiency it would be very unwise in any way to include thermodynamic losses. His own experience of the electric furnace was that it was extremely adaptable; it could be built round a job to get the highest possible heat transfer, and it was usually associated with a very high thermal efficiency. The gas furnace, however, could be adapted in the same way. It was only a question of design; and if gas furnaces were designed for the job, then he believed there would be no difficulty in carrying out many operations in this way which were now regarded as possible economically only by the electric furnace. Moreover, he believed it could be done at a lower cost. Another point about electric furnace design which had always appealed to him as of great importance was the power. When dealing with a furnace, it must be treated as a heat engine. In other words, the rate at which work could be done was very important. Usually in operations relating to the bulk treatment of metal over temperature ranges up to 1000° C.—for carburizing operations and other work which demanded temperatures above that range—the electric furnace with some form of wire or bar element was the most suitable type of electric appliance to use—there was a limited amount of energy per square foot of radiating surface available for the work; and this had been a very unfortunate circumstance as regards operating electric furnaces at big power inputs. He had in mind a carburizing furnace in which, without any difficulty, no less than 950,000 B.Th.U. per hour—*i.e.*, power input—could readily be added to the load, but the energy applied to the load allowing for an efficiency of about 30 p.ct. would give an input of about 320,000 B.Th.U. per hour with a wire-wound electric furnace of the same dimensions. Thus on the question of throughput the electric furnace was limited compared with the gas furnace, so that for a given capacity it meant there would have to be an increase of the number of units in use, with, of course, an increase in the capital expenditure. While average cost was very important, it was frequently over-estimated, and time was often a much more important factor in the final result. Because of this, there must be a reasonable power input to carry out the operations in a reasonable time.

Referring to the excellent paper by the American Gas Association, Dr. Walter remarked that the achievements in the gas industry in America corresponded with what had taken place in this country, and especially in the Midlands, with which he had had most experience. During last year the increase in the output of gas for industrial heating purposes from his works was 238 million c.ft.; and as an indication of how the industrial load was increasing year by year, he pointed out that, whereas in 1911 the industrial gas supply in Birmingham was 5 p.ct. of the total output, during the twelve months ended March 31, 1928, it was 21 p.ct., and out of a total of 14,000 million c.ft. no less than 2840 millions was used for industrial heating purposes.

COKE OVEN GAS DISTRIBUTION.

Dr. ROBERT MOND said that, as one of the pioneers of the introduction of the distribution of low power gas under pressure, it had been a source of satisfaction to him to find that after an interval of 25 years other people should have begun to study the problem with which he and those associated with him had to familiarize themselves 25 years ago when they started the central station for distributing producer gas in the district just north of Birmingham. This problem had before then been worked out to a large extent in the distribution of high-pressure natural gas in the United States; but there was a great difference between distributing a high methane 400 to 600 B.Th.U. gas and a 160 to 180 B.Th.U. gas, with which he was then concerned. He had always found it difficult to understand the very slow progress which the distribution of coke oven gas had made. It was a self-evident proposition that coke ovens should be heated with cheap producer gas from coke waste, and that the rich coke oven gas should be distributed through pipes, because, by distributing the poorer gas, larger pipes had to be employed, and, of course, they were more expensive. It had always been a great puzzle to him that it should have taken 25 years for this problem to have been undertaken; and he was pleased that their friends on the Ruhr were at last tackling the subject properly. These problems, like all technical problems, only fructified slowly; and it was necessary to have, with regard to them, a great deal more patience than nature had endowed most people with. The means of execution and making them practicable might be difficult, and might take time to elaborate; and it was rather a disappointment how slowly these things progressed. As Mr. Helps had said, it was possible to get all kinds of temperatures from all kinds of gases, whatever their chemical constitution happened to be; the only point was that, if a poor gas

was employed, it was necessary to have a definite system of regeneration to get the temperature required.

Flame Temperature and Stratification.

Mr. C. F. Hammond remarked upon the few references in the papers to the trouble through stratification in burning different classes of fuel—particularly gaseous fuel. In view of the remarks of Mr. Helps and Dr. Walter, it might be well to point out that the flame temperature of gases could be considerably increased if the question of stratification was looked after. His own recent experience showed that with ordinary town gas it was possible to reach an evolution of heat per cubic foot of combustion space which sounded very much like a fairy tale. The actual heat being evolved from a furnace with which he was working had been 15 million B.Th.U. per cubic foot of combustion chamber space per hour, which meant that the flame temperature must be very high indeed—about 3000° C. He was in full agreement with Mr. Helps that 200 B.Th.U. gas was useful for high-temperature work, as he had found it possible to get 10 million B.Th.U. evolved per cubic foot of combustion chamber space with a producer gas of that quality. A point arising out of Dr. Walter's remarks was that in working with electric furnaces the temperatures with wire-wound elements were limited to very small figures as far as the temperature gradient between the temperature of the furnace and that of the work being heated was concerned. The useful range of a wire-wound element was between 700° to 1000° C. The rate at which heat could be put into a cold object was immensely increased if there was a very high temperature gradient, because then it was possible to penetrate very much more quickly the viscous gas film which collected on the gas surfaces. This placed a limitation at present on the electric furnace, which need not be present in the case of a gas furnace. He had carried out these combustion chamber tests in a combustion chamber composed of the special heat-resisting steel of which Sir Robert Hadfield had spoken; and under the conditions prevailing there was no apparent flaking of the surface of the combustion chamber wall. Special precautions were taken to see that the temperature did not rise above 1200° C., but the performance reflected great credit on those responsible for producing such a steel.

Discussion on Section L: Utilization of Fuels for Domestic Purposes.

Dr. C. H. LANDER, Director of Fuel Research, presided at the meeting of this Section; and the General Report was read by Dr. Margaret Fishenden—see last week's "JOURNAL," p. 38.

Dr. Margaret Fishenden, in the capacity of Vice-Chairman of the Section, opening the discussion, said that in Great Britain every year 40 million tons of coal were used for domestic purposes, which amount had remained more or less constant for the last ten years. It was equal to the highest point reached before the war, and was equivalent to 20 p.ct. of the total home consumption. To dismiss lightly a consumption of this magnitude with suggestions for the complete or sudden abolition of existing appliances, which in Great Britain were the open grates and old-fashioned kitchen ranges, was rather precipitate. The use of raw coal was admittedly an unscientific, a troublesome, and a dirty process; but it also happened very often to be cheap. In any case the process of the substitution of raw coal was bound to be a gradual one. Suppose they were at once to replace all domestic fuel by gas and coke produced in the carbonization of coal in the gas-works. Then if they assumed that coke could be used with the same efficiency as coal, and that gas on the average could be employed with something like four times the efficiency, and if they assumed further that the householders would take the whole of these products from the gas-works, the capacity of existing gas-works would have to be nearly trebled. It seemed fairly clear, therefore, that a development of this order of magnitude was bound to take time. The Section had met to discuss means by which progress could be expedited. The responsibility for pointing out the easiest path of progress probably rested mainly upon the fuel technologist; but unfortunately—though it might seem strange—at this stage those paths were often not at all clear even to the expert. There were such a wide choice of fuels, and such a very wide choice of methods by which the fuel might be used, that they had not only to consider the fuels which were available, but must look forward to the products of processes which might be developed in the near future. Again, what basis should be taken for comparisons? Fuel A, though it might be intrinsically much more suitable than fuel B for some particular job, might still compare unfavourably if it were used in unsuitable appliances. However, thanks to the work carried out by various bodies both in this country and elsewhere, they knew to-day fairly well the working efficiencies of most types of domestic heating appliances. The great difficulty was to know how to apply them; and therefore she suggested that a census of requirements in domestic fuel would be very useful. It would probably have to be based on a census of consumption for various purposes, and it would be a great help in estimating the best methods. It was known that gas and electrical appliances in general were much more efficient than coal appliances, and that they could also, for certain purposes, be equally cheap; but if an attempt were made to replace coal entirely by gas and electricity, it would have, in general, a very serious effect on the consumers' bills. A great deal more attention had been paid towards making gas and electric appliances efficient than in the case of coal fires and solid fuel appliances, and it was obvious that these could be greatly improved. Gas was far cleaner and more convenient, and electricity, leaving out of account its high cost both in initial fuel expenditure and to the consumer, could be regarded as almost ideal. For economic reasons, however, the day of solid fuel in the household was far from over. What, then, must be done about this? Everybody deplored the waste and dirt associated with the use of raw coal. Fortunately, for some purposes, coke of suitable properties was an altogether satisfactory substitute for raw coal. The possibility of the production of low-temperature cokes would be considered at a special Section of the conference; and she would not go into that question. The gas undertakings were also realizing that there might be further considerable outlets for coke in the domestic market, and were paying attention to the possibility of improving the quality of their cokes. Probably there would be room in the future for the development, side by side, of different types of carbonizing processes. There certainly seemed room for considerable extension of some sort of carbonizing process to meet the needs of domestic requirements. At any rate, it appeared that the immediate prospects for an improvement of the smoke nuisance lay in a proper co-ordination of the use of gas, solid fuel, and electricity. In the meantime it was of importance not to neglect the appliances for burning raw coal, and to see that everything possible was done to burn what coal had to be burned as efficiently, economically, and inoffensively as possible.

Heating Load of the Gas Industry.

Mr. Stephen Lacey (Gas Light and Coke Company) remarked that the representatives of the various fuel supply industries welcomed the opportunity afforded by the conference to re-examine the economic foundations of the business, to measure relative progress, and to satisfy themselves that the competition which stimulated their everyday efforts led to the best possible use of the fuel resources of this country. The papers presented that morning were all of great interest; but the one written in a form peculiarly suited to this conference was that of Dr. Margaret Fishenden on "A Comparative Study of Solid Fuel, Gas, Electricity, and Oil for Domestic Purposes." Dr. Fishenden gave chapter and verse for all her comparisons and conclusions; and though some might wish to challenge one thing, and some another, no one could refute the broad conclusions arrived at. In the first place, he wished to correct an impression given by a quotation from Sir Dugald Clerk in Dr. Fishenden's paper. Dr. Fishenden said that in 1919 Sir Dugald Clerk gave as the probable division of coal gas in the United Kingdom: Heat 55 p.ct., light 35 p.ct., and motive power 10 p.ct. These figures were far from true to-day, whatever might have been the fact in 1919. He could not give figures for the whole country, but for the Gas Light and Coke Company the estimate was: Heat 86 p.ct. (including 10 p.ct. industrial heating), lighting 12 p.ct., and motive power 2 p.ct. Dr. Fishenden had made it very clear that there were two distinct tests that should be applied when comparing the relative merits of coal and fuels derived from coal in regard to various uses. There was, on the one hand, the criterion of cost to the user, and, on the other, the criterion of the coal consumption entailed in the production of the fuel. In her paper, Dr. Fishenden said: "It does not, of course, follow that the fuel which costs the consumer least for any purpose will be the one entailing the minimum coal consumption." This was clearly true; and it was therefore fortunate that coke and gas, which were derived from the same manufacturing process and might be considered as complementary, must be awarded first place in the realm of heating, whichever of the two criteria was adopted. The fundamental facts that were brought in the paper ought by now to be familiar to all educated people interested in fuel questions; but they were certainly not. For example, consideration of the relative thermal efficiencies of the production of gas and electricity showed the great handicap with which electricity started competing in the field of domestic, or, indeed, in any other form, of heating. If it were not for the high efficiency of utilization of electricity, its proper use for heating (where it was derived from coal) would be restricted to a fuel even more limited than at present. It was in the direction of more efficient utilization that Dr. Fishenden's paper should stimulate the gas industry to further endeavour. Scientific method devoted to increasing the efficiency of utilization of gas had made great progress lately, but much more remained to be done; and it would be done. Finally, he said that the suppliers of electricity in this country were naturally reluctant to accept the position that domestic heating was, generally speaking, outside their economic province—particularly when the public had been led to believe that the production of electricity was somehow exempt from the natural laws which governed the transformation of energy. The result was that in some cases electricity was sold for domestic heating at abnormally low rates. The startling differences in charges for lighting and heating were generally accounted for by the improvement in load factor which was alleged to result from the addition of a heating load to an existing light and power load. How that could be reconciled with the fact that the heating load overlapped the winter lighting peak he had never been able to understand. It did not seem that differential charges of this kind should be made, having due regard to coal conservation and fairness to consumers using electricity for lighting and power.

Flueless Gas Heaters.

Mr. J. G. Clark (Gas Light and Coke Company) said that the reference in Dr. Margaret Fishenden's paper to flueless gas heaters

required some revision. This was a subject which had been receiving a great deal of attention recently; and he did not know whether Dr. Fishenden, in making the statement in question, had taken that into account. It was safe to say now that the combustion of the most recent gas stoves was as perfect as scientific knowledge would permit. It was true that they did not ventilate a room like the ordinary gas fire, but in this respect they were like the electric fire; ventilation had to be provided in some other way. Reference was also made by Dr. Fishenden to the efficiency of gas ovens, but Dr. Fishenden knew as well as he himself knew how difficult it was to assess the efficiency of a gas oven in the same way, for instance, as one could assess the efficiency of a boiler. Personally he had not yet discovered a method which would permit of a true expression of oven efficiencies in terms of an actual percentage. We had to be content to express the efficiencies in terms of B.Th.U. consumption for a given job; and it would be a very good piece of work if somebody would investigate the actual conditions under which the efficiencies of gas ovens should be assessed. He was not sure whether Dr. Fishenden's figures took account of the most recent gas cookers. From the paper it appeared that, considered on a thermal basis, the electric oven was thermally twice as efficient as the gas oven; but he did not think this was quite the case. Gas was in a better position now; and he would rather put the thermal efficiency of gas at 100 and electricity at 160 or 170 in this respect; the paper gave 100 and 200. The gas industry, however, was not satisfied with the present efficiencies; and one of the pieces of work on the programme of the Gas Light and Coke Company was to make some heat balances to ascertain where future development might possibly be successful. In regard to the relative uses of electricity and gas, he was recently in places in Canada where electricity was very cheap; and he was astonished at the very small use made of electricity for domestic purposes other than lighting. Dr. Fishenden's paper contained a reference to the production of carbon monoxide from gas hotplates, and the statement would rather give the impression that the gas industry was not alive to the conditions under which gas should be burned in relation to hotplates. The relation of the vessel to the flame was well understood, and in the most recent apparatus the carbon monoxide difficulty referred to in the paper was practically non-existent. The troubles alleged in the paper had been taken care of for several years. There were also some references in the paper to the thermal consumption in the case of electricity and gas cooking; but he could not help coming to the conclusion that Dr. Fishenden had only taken the performances in the ovens as a basis for the comparisons. It happened, however, that though electricity might be used a little more efficiently in the oven than gas could be, the reverse was the case as regards the vessels supported on the hotplate. In the case of saucepans and kettles, the efficiency was very different from that of the oven, and much to the advantage of gas. As the result of work by the Gas Light and Coke Company he would put the efficiency of the hotplate at four times that of the oven; and therefore, taking the cooker as a whole, the figures in the paper ought to be modified.

The paper also seemed to suggest that gas could not be economically applied to large-scale water heating. It was described as heavy hot water work; and he was not sure what was meant by that. The fact remained, however, that a considerable amount of work was being done economically by gas—for instance, in public baths, where huge quantities of hot water had to be supplied, in several cases in London, as well as in swimming baths, where the water had to be at a cerain minimum temperature. All that was large-scale work. In cinemas, also, where they had central boilers, large quantities of hot water were supplied by means of gas heating. One reason why gas was used for this purpose in cinemas was because the heat could be thermostatically controlled to take advantage of the variations of the temperature outside. The gas consumption was thermostatically reduced according to the atmospheric temperature, and in this way the cinemas were prevented from becoming overheated.

Radiation, Convection, and Ventilation.

Mr. C. A. Masterman (Gas Light and Coke Company) remarked that, in relation to house heating by various fuels, figures were advanced showing the comparative efficiencies of different systems. These comparisons were drawn up on the assumption that all the heat passing through an imaginary plane or shell from the heating unit into the room was equally effectively used. On this basis, identical efficiencies must sometimes be allotted to systems embodying quite different directional distribution of radiant heat, and having dissimilar ratios of radiation to convection components of heat output. Thus, a flueless gas stove and an electric radiator were said to possess the same efficiency, though one might be primarily heated by convection, the other by radiation. A sounder comparison where unlike systems were concerned surely rested upon the comfort conditions produced. These conditions had, of course, been subject to considerable research; but controlled trials covering numerous lay observers remained the only method of obtaining factors for the correction of the conventional efficiencies for unlike systems. He knew this fact was realized in general, but it was apt to be overlooked when comparative figures were analyzed. He questioned the unqualified acceptance of about 100 p.ct. efficiency for flueless heaters, whether electric or gas. Coal, coke, or gas fires operating into a flue concentrated the air outlet from the room; and the heat content of this air was accounted as waste, together with the balance of heat in the flue products proper. In the absence of a flue there was and should always be air movement in and out of the room, however bad the ventilation. It rarely fell below one air exchange an hour. The air passing out carried with it heat precisely as did the air drawn into the flue above a ventilated fire. But this heat loss with a flueless heater was not debited against the efficiency. For the figures of the two systems to be comparable, it was essential either to lower the efficiency figure of the flueless heater by the amount of this loss, or to raise the figures for apparatus working into a flue by taking this into account. The latter might be preferable since this warm air before leaving had contributed to comfort conditions. In any particular case the dimensions of the correction might be easily calculated, and would usually be found to be of the order of 5 to 15 p.ct. on the efficiency figure.

Thermal Insulation.

Passing on to intermittent domestic hot water supply systems, he said that in connection with the Gas Light and Coke Company he had been associated with an extended series of trials of such systems. With the exception of instantaneous heaters of the geyser type, the heat units actually drawn by the user in the water corresponded to an over-all efficiency rarely in excess of two-thirds of the tested boiler efficiency, and were frequently under one-third of this amount. The balance was represented by heat lost by the water during storage. Here there was an immediate field for fuel conservation—a field in which they in this country had lagged some way behind common practice overseas. He referred, of course, to the thermal insulation of domestic hot water supply systems. It was usual to lag large industrial installations; but in domestic installations, where the higher surface volume ratio made the need more acute, such insulation was infrequent. A lagging material for domestic use must fulfil searching requirements involving thermal capacity, as well as insulation; hygiene; ease and cost of application; &c. The ideal material had yet to be discovered; but using ½ in. hair felt, 1½ in. asbestos cement, or equivalent thickness of other recognized materials, it was found that during average running 90 B.Th.U. per sq. ft. of exposed surface per hour might normally be saved by lagging. In passing, he observed that the less efficient the boiler, the greater the fuel economy. In order to contribute these wasted 90 B.Th.U. to the water, a 70 p.ct. efficiency boiler would require 130 B.Th.U. in fuel. It was not the moment to advance a mass of figures, but the conditions would be exceptional in which the cost of the lagging on any kind of storage installation would be in excess of the cost of the fuel saved during the first year. On the one hand, with the cheaper fuels such as coal or coke, the stand-by losses when water was drawn off intermittently were very high, while the easier control of the alternatives, gas and electricity, was off-set by the higher price of the heat unit supplied. He assumed, of course, that all normal domestic needs were supplied from the one apparatus, not that the installation was operated for a single weekly bath. The figures obtained showed a saving, consequent upon this elementary degree of lagging, of rarely less than 10 p.ct., and often up to 50 p.ct., in fuel consumption for typical domestic usage. Alternatively, if heat under thermostatic control was supplied, the installation might be maintained hot continuously at the same fuel consumption as an unlagged installation to which heat—and only just sufficient heat—was supplied in immediate anticipation of actual demand. This latter programme presupposes an unusually careful control, while the advantages of the former in labour saving and ever-ready hot water were obvious.

It had been advanced against such thermal insulation that the hot water system would no longer keep the house warm. There was, however, an appreciable amount of warm weather during the summer, and the unlagged system was then uneconomic, uncomfortable, and sometimes intolerable. The ideal lagging material might perhaps be required to be capable of removal during the winter months. When adopting insulation, one point must not be overlooked. Excessive heating of the water soon led to scaling troubles, and, if carried too far, to boiling. Hence there was a limit to the degree of insulation appropriate, except where a controlled heat supply was available which could be adjusted to diminish the heat input in ratio to the reduced heat losses. He had suggested that in this matter this country was behind common practice overseas, but the reverse should be the case. Throughout the country they had inherited from the past thousands of old domestic installations, which had been modified and added to, until the heat losses were abnormally high. To meet the resulting inefficiency, the original boiler had often been replaced by a more modern apparatus. The over-all efficiency remained low, however, and the new apparatus was frequently brought into undeserved disrepute. Failing a reconstruction of the old installation, much might be done to restore a reasonable efficiency by the use of lagging—not, of course, on the boiler alone, but primarily upon the pipelines and storage. He could conceive no more direct contribution to the conservation of fuel than the retention in the proper sphere of the heat units at present escaping from these unseasonable and involuntary central heating systems which only masqueraded as domestic water supply installations.

Systems of Charge.

Dr. E. W. Smith remarked that the subject of domestic heating was primarily an economic one. He contended that for efficient heating of rooms it was necessary to have some form of radiant heat which would heat the walls and the furniture, these heating the air of the room. That was the most efficient means of heating a room. Radiant heat could be obtained very efficiently from electrical appliances, but unfortunately this was an expensive method; and the most important point, he felt, was to study methods of charging both for electricity and gas. There had recently been a "boost" in the newspapers for a reduction in the charges for electricity. If, however, the general Press would realize that gas was used in 90 p.ct. of the houses in the country, it would appreciate that it had a subject worthy of close study. It was the fact that many consumers were being supplied with their gas at a great deal below the cost of production; and owing to the system of charging, those consumers who were using gas largely for heating were paying for the use made of it by other consumers. There was ample scope for the Press to educate the public in this matter of charging in the gas industry, which had not the freedom to adopt a real commercial basis which was enjoyed both by the coal and the electrical industries. If a proper commercial basis could be adopted, instead of an all-round flat charge, the users of gas for heating would get it much more cheaply than they now did. There should be developed a public

opinion which would insist that some consumers should not pay for others; and if the conference went into that matter, and could encourage the gas industry and its consumers to discuss the position, it would have done a great thing.

Viewpoint of the Electricians.

Col. W. A. Vignoles (Director of the British Electrical Development Association) said there seemed a tendency to ask for the sympathy of the public in favour of the gas industry, because of the extraordinary efficiency of the process of carbonization and the large number of heat units obtained from the coal carbonized. This, however, was looking at the matter from a rather narrow point of view. What the nation and the collieries were more concerned with was that every ton of coal brought to the surface should be used; and it was too often overlooked that a class of fuel was burned in electricity generating stations which would not find a sale elsewhere. It must be recognized that there were only special classes of coal which could be carbonized by the gas industry, and equally there were special classes of coals used in the generation of electrical energy. From the point of view that the electrical industry utilized low-grade fuels which might otherwise be put on the dump heap, the electrical industry also deserved the sympathy of the public.

Atmospheric Pollution.

Captain J. F. Shaw (Fuel Research Board), speaking as to the pollution of the atmosphere, observed that a great deal needed to be done in regard to the waste products from electric power stations, and mentioned a case near London where trees were being destroyed owing, it was believed, to the waste products from the chimneys of a power station. From the domestic point of view, it seemed to him that the only means by which the atmosphere would not be polluted would be by the use of purified gas, not necessarily coal gas as supplied at present, but in some other form, and that would be an expensive business.

General Report on Section O: The Transmission of Power.

By F. S. TOWNEND.

This Report was presented on Wednesday, Oct. 3, when the Section met under the chairmanship of Dr. C. Matschoss, of Germany, who suggested that the technical problems of long-distance gas transmission might now be regarded as solved.

This General Report covers three of the papers comprising Section O—namely:

(*a*) "Problems of Long-Distance Gas Transmission" (Germany), by Dipl.-Ing. Traenckner.

(*b*) "The Transmission over Various Distances of Energy in the Form of Coal, Oil, Gas, and Electricity" (Great Britain), by Dr. E. W. Smith.

(*c*) "Legal Aspects of Gas Transmission" (Great Britain), by H. V. Lloyd-Jones, Barrister-at-Law.

In the contribution on the "Transmission over Various Distances of Coal, Oil, Gas, and Electricity," E. W. Smith presents data from authoritative sources on the cost per therm of potential heat of transmitting coal, coke, oil, gas, and electricity over distances ranging from 5 to 100 miles. The cost of conveying one therm of potential heat in the form of coal and coke by rail in Great Britain is less than that of conveying it in the form of oil. Taking the distance of 50 miles, the figures are for coal 0·21d., and for oil 0·35d. per therm.

The cost of transmitting gas varies not only with the distance, but also with the quantity delivered per day. Taking, again, the distance of 50 miles, the cost varies from 0·64d. to 0·334d. per therm as the quantity increases from 5 million to 50 million c.ft. per day. It can, therefore, be considered as still comparable with coal and oil from this point of view.

The cost of transmitting electricity is on the whole much more expensive per therm than coal, oil, or gas. It depends very largely on the load factor and on the system of distribution. Taking, as an example, a distance of 50 miles, the cost varies from 0·756d. to 2·35d. per therm according as the load factor decreases from 100 p.ct. to 25 p.ct.

The data is used to estimate the total cost to the community of transmitting energy in different forms under pre-supposed conditions. It is calculated that in Great Britain in 1925 approximately £17,000,000 was spent in the transport of domestic coal and coal used in gas and electricity works. If the energy demands supplied by this raw coal had been satisfied by gas and coke in the proportions as generally produced on gas-works, a reduced amount of coal would have required transporting for carbonization purposes; and it is calculated that a saving of the order of £5,000,000 to £7,000,000 per annum would be possible. Moreover, it is pointed out that the corresponding saving is much less if electricity were the universal medium of energy. The conclusion may therefore be admitted that there is every justification in encouraging the extended use of gas and coke under the present organization of the gas industry.

Transmission of Gas.

Three aspects are involved—namely, technical, economic, and, at any rate, in Great Britain, important legal considerations.

Technical.—In the paper on "Problems of Long-Distance Gas Transmission," Dipl.-Ing. Traenckner states that the problems connected with the construction of gas mains and those relating to the behaviour of the gas in the main itself have, on the whole, been solved. Steel mains with welded joints have been proved to be entirely satisfactory as regards mechanical strength, provided that expansion joints are used at suitable points. Protection against stray electric currents and corrosion, however, still remains more or less unsolved.

Attention is called to the precautions necessary to ensure the safety of the supply. First, a system of automatic supervision is required whereby serious leakage is immediately noted. The safety factor is still further increased by interconnecting trunk service mains; and, finally, the connection of several producing stations to each network of main ensures the utmost security of long-distance supply possible.

It is of very great interest to note that several years' working in Germany has shown that trouble either with condensation or blockage by naphthalene deposits need not in general be anticipated. In spite of this, various attempts to free the gas completely from naphthalene have been made, particularly by methods involving freezing of the gas. Such processes are generally high both in first cost and in operating charges.

Economics.—For any given length of main, quantity of gas delivered, and final pressure required, there is a certain inlet pressure and diameter of main which gives the lowest cost of gas transmission. The two items which largely determine this most economic cost are the cost of power for compression and the cost of main laying, more particularly the period over which amortization of the capital cost is allowed.

E. W. Smith suggests that there is a limiting distance beyond which it is cheaper to rail coal for gas-making than to convey gas and the coke which is absorbed in the same area as the gas. It is pointed out that, in most areas of gas supply, for every 15,000 c.ft. of gas sold there is approximately 10 cwt. of coke absorbed. If a long-distance gas supply is substituted for local gas production, and the market is retained for coke, then the community must meet the transmission costs of gas and coke. From the data in the paper it appears that there is a limiting distance varying from 5 to over 100 miles, depending on the quantity of gas required, beyond which it is cheaper to rail coal than the equivalent gas and coke. Thus, unless the gas is produced definitely more cheaply outside the area of supply than within it, then the economic distribution of gas is limited to distances of the order given in the paper, if no extra cost is to be borne by the community. Such a condition, it is emphasized, does not apply in the case of coke oven gas, when it is available at a cheap rate owing, for instance, to the price of metallurgical coke being higher than that of gas coke. It is not intended to dogmatize on the inevitability of these limiting distances, but it is necessary to view the question of long-distance transmission of gas in correct and complete perspective.

Legal Considerations.—It is but seldom that due importance is given, when discussing the long-distance transmission of gas in Great Britain, to the widespread legal issues involved. The paper on "Legal Considerations Governing Long-Distance Transmission of Gases," by H. V. Lloyd-Jones, clearly indicates that before bulk transmission of gas on a national scale can be made practicable, nothing short of a complete reshaping of the law relating to gas supply must be undertaken. For the considerations which lead to this position, the paper itself must be consulted; but one or two salient points may be referred to here.

All the large centres—in fact the bulk of the gas supply of Great Britain—are in the hands of statutory companies and local authorities which, in exchange for the obligations of working under certain restrictions, enjoy a number of privileges, among which is a monopoly of the supply of gas within their areas. According to H. V. Lloyd-Jones, it is unlikely that Parliament would give power to an outside undertaking to supply gas within these statutory areas. While there are no similar obstacles to a private company supplying long-distance gas to non-statutory areas, there are indirect legal obstacles which, for practical purposes, would prove insurmountable.

The paper indicates that the most practical suggestion would seem to be a general reshaping of the gas supply by an amending statute similar to the Electricity (Supply) Act of 1926, by following the broad lines of which it would be possible to provide for the utilization of surplus coke oven gas and its trans-

mission over long distances. This would, of course, entail the repeal of most of the existing laws on gas.

It may be permitted in this General Report to suggest that, if the vital interests of the nation warrant it, a change of legislation such as is indicated in the paper is justifiable. Consideration may, however, lead to the conclusion that the circumstances which gave rise to the recent reorganization of the supply of electricity in Great Britain do not operate in the same way as regards the supply of gas. On one point alone there is an important difference. Small gas undertakings can, and, indeed, often do, operate at the same efficiency as large undertakings; the load factor having by no means the same influence as in the case of electricity. Further, in general, gas undertakings of all sizes are already producing gas at such a price as is attractive for lighting, heating, and cooking. It is probable that the legislative changes as regards methods of price regulation being sought by the gas industry will still further help in this direction; and such changes are within the general framework of the present law on gas.

Summing up the leading ideas contained in the papers covered by this General Report, data on the cost of transmission of energy in various forms are presented which suggest that there are certain limits of distance within which the bulk supply of gas and electricity will be confined. As regards the long-distance transmission of gas, technical problems are largely solved; but in the case of Great Britain there are formidable legal difficulties which must be surmounted before bulk supply of gas becomes practical politics.

Transmission Over Various Distances of Energy in the Form of Coal, Coke, Oil, Gas, and Electricity.

By Dr. E. W. SMITH.

Authoritative Body: Technical Committee, Fuel Conference, 1928.

[Extract.]

The data on which this communication depends have been obtained from authoritative sources in each of the industries concerned. The Technical Committee put forward this communication with no idea that its conclusions will solve once and for all the questions that have been raised. Each problem arising will always have to be solved by taking account of the special local circumstances. Nevertheless, the object of this communication is to give a broad idea as to the order of the relative costs that hold when considering the alternative methods of energy distribution. It is desired that the reader shall receive a general impression, and to that extent only can the paper achieve its object. The Technical Committee are indebted to the authorities concerned, and particularly to Mr. F. S. Townend, who has assisted the Editor in the co-ordination of the data.

DATA ON COSTS OF TRANSMISSION.

COAL AND COKE.

The figures given in Table I. for the cost of conveyance in the railway company's wagons per ton of coal and coke represent the average for the whole of Great Britain, compiled by the Ministry of Transport. They are *actual* railway charges as distinct from the *standard* railway charges approved by the Railway Rates Tribunal. These latter, while forming a general basis, are subject, in probably the majority of instances, to appreciable reductions—which depend on local circumstances, such as quantity of individual deliveries, location of consumer, &c. The figures given in the table are averages for the different distances, taking all these exceptional rates into consideration. In general, they are between 25 and 42 p.ct. less than the standard rates. Rates for coal for shipment are still less; the figures in Table I. referring to landsale only. It may be noted that the average rail-haul for landsale coal throughout Great Britain is 54·5 miles and for coal for shipment 24·26 miles. The costs given in the table cover conveyance, wagon hire, and station terminal charges. They do not take into account such transmission losses as evaporation of moisture, &c.

TABLE I.—*Cost of Conveyance by Rail of Coal, Coke, and Fuel Oil.*

Distance in Miles.	Coal and Coke per Ton.	Oil per Ton.	Coal per Therm.	Coke per Therm.	Fuel Oil per Therm.
	s. d.	s. d.	Pence.	Pence.	Pence.
5	1 3	4 10	0·050	0·054	0·136
25	3 6	8 9	0·139	0·150	0·246
50	5 3	12 4	0·209	0·225	0·348
100	8 6	17 5	0·338	0·364	0·491

Gross calorific values assumed:

Coal	13,500	B.Th.U. per lb.
Coke	12,500	,, ,,
Fuel oil	19,000	,, ,,

OIL.

The figures given in Table I. as the cost of conveyance by rail *per ton* of oil have been furnished by one of the large oil distributing companies. They cover (*a*) delivery from storage tank into rail car, (*b*) railway rates averaged from exceptional rates over the whole country, and (*c*) rail car hire. The actual cost of pumping out of the rail car is borne by the consumer, and, as such, is not included in the data given in the table. A figure of 13d. per ton may be considered representative of this charge.

In converting the cost of conveyance of coal, coke, and oil *per ton* into the corresponding costs *per therm*, the calorific values given in Table I. have been used. These are gross heating values, and thus the figures represent the cost per therm of total potential heat.

GAS.

In Table II. are given the costs of transmission of different quantities of gas over varying distances, based on the data recently published by S. Lacey.[1]

TABLE II.—*Cost of Transmission of Gas in Varying Quantity Over Varying Distances.*

—	Pence per 1000 C.Ft.			Pence per Therm.		
Quantity of gas per day, c.ft.	5 mill.	25 mill.	50 mill.	5 mill.	25 mill.	50 mill.
Equivalent therms per day	25,000	125,000	250,000	25,000	125,000	250,000
5 miles	0·51	0·27	..	0·102	0·052	..
25 ,,	2·00	1·28	1·03	0·400	0·256	0·206
50 ,,	3·20	2·24	1·66	0·640	0·448	0·334
100 ,,	..	3·65	2·74	..	0·730	0·548

Calorific value of gas assumed at 500 B.Th.U. per c.ft. (60° Fahr. and 30 in. saturated).

In calculating the figures, the most economic sizes of mains and inlet pressures, assuming that the terminal gauge pressure is 1 lb. per sq. in., have been determined. These, however, depend largely on the cost of power for compression and the cost of the mains, including the laying thereof. While Lacey's data have been chosen to give average conditions in this country, appreciable variations from the figures given in Table II. may conceivably be expected. If there is a specially cheap source of power—say, from waste heat—the cost of transmission of gas would show a reduction. If the main is laid through important thoroughfares of a town or along arterial roads where main-laying is expensive, the cost would be increased. On the other hand, if it is possible to lay the mains for long distances on the green verge of roads or through open country, the cost would be reduced. It is a combination of the factors making for low costs of transmission which has determined the extremely high compression and relatively long distances economically permissible in the bulk gas distribution schemes in Germany. The figures given in Table II. assume that the whole of the different volumes of gas travel through the whole of the distances stated. For very long distances this would seldom be the case, as, without doubt, it would be arranged to take off supplies to villages and country towns en route. This would effect, to some considerable degree, the cost of distribution. It is essential when investigating schemes of distribution of gas that each be examined on its own merits.

THE INFLUENCE OF COST OF TRANSMISSION OF VARIOUS FORMS OF ENERGY.

It is proposed to illustrate, with the aid of the data already submitted, some instances of the influence which the cost of transmission of energy in various forms exerts on the final cost of energy to the community.

Coal is the ultimate source at present of practically all domestic and industrial energy in Great Britain, and is likely to continue as such during the future. Moreover, by far the greater proportion of these energy requirements are satisfied by the combustion of coal in its raw state. Coal must be produced

[1] "GAS JOURNAL," Vol. 182, p. 889.

where coal is found—that is, in the coalfields—whereas, the points of consumption of the energy in the coal, whether required as coal or as its derivative forms—coke, gas, and electricity—are spread over the whole of the country. There is no question, except where special local circumstances are favourable, that the most economical method of obtaining energy is by production in bulk, but it is often accepted, without adequate thought, that the situation for the most economical production of the above derivative forms of energy is also at the coalfields. This involves the bulk transmission of coke, gas, and electricity. But, in fact, the charges involved in the production of energy as gas or electricity, other than the cost of coal, can be, and indeed often are, as favourable at the area of supply as at the colliery. In this case the only factor which would lead to a difference in the cost of the derived form of energy at the area of supply would be any difference between the cost of conveyance of coal from the colliery and transmission of the resulting gas or electricity. The question therefore arises, Which of the two involves the lesser cost to the consumers in the area of supply—the cost of conveying the coal for the local production of energy, or the cost of transmitting the energy in its final form from the colliery?

While the problem has been stated in terms of colliery and area of supply, the same problem arises when dealing with two areas of supply, one of which is more remote in a direct line from the colliery. In this case, the question is, Which is the more economical scheme for the remote area—to undertake the cost of transmitting energy as gas or electricity from the nearer area, or to undertake the extra rail charges on coal for energy production in the remote area? It is proposed to give the results of the investigation of some typical instances in which the costs of transmitting coal, gas, and electricity would largely determine the situation of the point of generation in relation to the area of supply.

Coal Gas Production.

Let us assume that a particular area requires a daily supply of 25 million c.ft. of coal gas. Two schemes are available for supplying these requirements:

(*a*) Coal can be railed from some colliery to the particular area and the gas produced at that point.

(*b*) Coal can be carbonized at the colliery, and the resultant products of carbonization—coke and gas—transported into the area of supply.

The problem is not quite so simple as that of electrical generation, since, in the manufacture of coal gas, for every 15,000 c.ft. of coal gas produced there is approximately 10 cwt. of coke for disposal. In other words, the cost of conveying the coal in scheme (*a*) in effect conveys 15,000 c.ft. *plus* 10 cwt. of coke to the point of consumption. Assuming that all other costs are similar, the problem, therefore, resolves itself into comparing the cost of conveying 15,000 c.ft. of gas *plus* 10 cwt. of coke from colliery to area of supply with the cost of conveying one ton of coal the same distance. As the cost of gas transmission varies with the quantity delivered, the figures in the following table are given in the form of the total amount expended on transport per day.

Daily Cost of Conveying Coal for Coal-Gas Manufacture Compared with Conveying the Resulting Gas and Coke.

Distance (Miles).	—	Quantity of Gas per Day in Millions of C.Ft.		
		5	25	50
		£	£	£
5	Coal	21	104	208
	Gas and coke	21	80	..
	Difference (coal-gas and coke)	*Nil*	+24	..
25	Coal	58	292	584
	Gas and coke	71	280	506
	Difference (coal-gas and coke)	−13	+12	+ 78
50	Coal	87	437	874
	Gas and coke	110	451	785
	Difference (coal-gas and coke)	−23	−14	+ 89
100	Coal	142	708	1416
	Gas and coke	..	734	1278
	Difference (coal-gas and coke)	..	−26	+138

These figures show that, for a comparatively small quantity of gas, such as 5 million c.ft. per day, it is cheaper to convey gas and coke distances up to the order of five miles than to rail the coal necessary for gas-making purposes. For distances beyond five miles it is cheaper, however, to rail the coal than to convey gas and coke.

For quantities of the order of 25 million c.ft. of gas per day the economic limit appears to be between twenty-five and fifty miles—say, about thirty-five miles. Up to that distance it is cheaper to transmit gas and rail coke. For distances beyond about thirty-five miles it is cheaper to convey the coal for gas-making.

For large quantities of gas of the order of about 50 million c.ft. per day it would appear to be cheaper to pump gas and rail coke for distances up to 100 miles and beyond. There may be some distance greater than 100 miles at which it becomes cheaper to rail coal.

The foregoing is an arbitrary comparison assuming that the other charges entering into the cost of production of gas are the same at the colliery and at the area of supply. If, however, as in the case of coke oven plants where the gas is produced as a bye-product, and where, in ordinary circumstances, a better price is obtained for metallurgical coke than for gas coke, the above considerations would not apply. The surplus coke oven gas should then be available at a price which, together with the transmission cost, would enable it to be delivered at an economic price at greater distances than those indicated.

Cost of Transport of Energy for Domestic Purposes in Great Britain.

It is of interest to estimate, with the aid of the data already given in this communication, the annual cost to the community of transporting the present requirements of energy, in the form of coal for domestic purposes, from colliery to consumer, and to determine if any reduction would be obtained if the raw coal now used were replaced entirely (*a*) by products of carbonization—*i.e.*, gas and coke—and (*b*) by electricity.

Considering only the coal consumed *as coal* for domestic purposes, together with that used in gas and electricity works, during 1925, 64,700,000 tons of coal were used, dissected as in column 2 of Table III.

Table III.

Consumed by	Coal Consumed in Tons.	Heat *Available* after Conversion: stated as Equivalent Tons of Coal.	Heat *Effective* in Use: stated as Equivalent Tons of Coal.
Domestic user	40,000,000	40,000,000	6,000,000
Gas-works	16,452,000	13,150,000	4,600,000
Electricity works	8,250,000	1,650,000	1,650,000
Totals	64,702,000	54,800,000	12,250,000

Assuming that the efficiency of heat conversion in a gas-works is 80 p.ct. and in electricity generation 20 p.ct., the heat *available* after conversion (stated as equivalent tons of coal) is as given in the third column. Assuming that the overall efficiency of utilization is 15 p.ct. for domestic coal, 35 p.ct. for gas and coke, and 100 p.ct. for electricity, the effective heat requirements in use (again stated as equivalent tons of coal) will be 12,250,000 tons of coal (fourth column of Table III.). In other words, while the heat requirements for domestic purposes for gas and for electricity in 1925 were equivalent to 12,250,000 tons of coal, it was necessary to mine, transport, and consume 64,700,000 tons of coal.

It has already been stated that the average rail-haul for inland coal is about fifty miles, and the cost to transport one ton of coal this distance is 5s. 3d. (Table I.). The annual cost to the community of transporting 64,700,000 tons of coal, therefore, is £17,000,000.

Replacement by Gas and Coke.

Let it be assumed that the heat requirements—namely, the equivalent of 12,250,000 tons of coal, be satisfied entirely in the form of gas and coke, then the total coal required to be carbonized would be

$$\frac{12,250,000}{0{\cdot}8 \times 0{\cdot}35} = 45,300,000 \text{ tons.}$$

If this were carried by rail fifty miles from colliery to consumer, the cost to the community of transport at 5s. 3d. per ton would be £11,900,000.

If, however, this coal were carbonized at the colliery, and the coke and gas products in the proportion of 75 therms of gas and 10 cwt. of coke were transported fifty miles, the cost of transport per ton of coal carbonized is given by

$$75 \times 0{\cdot}334\text{d.} + 0{\cdot}5 \times 5\text{s. } 3\text{d.} = 4{\cdot}7\text{s.},$$

and the annual cost to the community would be

$$\frac{45,300,000}{20} \times 4{\cdot}7 = £10,650,000.$$

Thus it appears that, if all the heat requirements now being satisfied by domestic coal and by gas and electricity undertakings were met by gas and coke only, there would be a yearly saving in the cost of transport of between five and seven million pounds sterling.

Replacement by Electricity.

If now these same heat requirements were covered by the generation of electricity at a conversion efficiency of 20 p.ct., the amount of coal required would be

$$\frac{12,250,000}{0{\cdot}2} = 61,300,000 \text{ tons.}$$

The total cost of transporting this amount of coal from

colliery to electricity works, an average of fifty miles, is 61,300,000 × 5s. 3d. = £16,100,000.

If, however, the electricity were generated at the colliery and distributed over an average of fifty miles, the total cost would be

$$\frac{1,650,000 \times 290 \times 1{\cdot}3}{240} = £19,300,000,$$

where the total heat in one ton of coal is 290 therms and the cost of transmitting electricity at 50 p.ct. load factor a distance of fifty miles is 1·3d. per therm.

It is therefore seen that if the heat requirements for domestic purposes, in the form of raw coal, of gas and of electricity in 1925 (and those in 1928 may be taken as very little different) had been satisfied by electricity alone, the cost to the community for the transport of the energy would, if the electricity had been generated at the point of consumption, have been practically the same as at present, and if the electricity had been generated at the colliery, would have been increased by some £3,000,000.

A consideration of these figures indicates that if the heat requirement for domestic purposes, including those now met by gas and electricity undertakings, were satisfied by the products of carbonization of coal—gas and coke—as undoubtedly they can be, considerable savings on the score of the cost of transport of energy could be effected as against the present method of using raw coal, and, further, that the complete replacement by electrical energy offers very little, if any, such savings. It might even be that the cost of transport of energy to the community would be appreciably greater.

In conclusion, it should be emphasized that the costs of conveyance of energy in the three instances given above are based on the arbitrary condition that the production costs at the colliery are the same as at the area of supply. While this may well be the case, there are possibilities—for instance, where gas or electricity are secondary products of some primary process—that the energy is available for sale at a less figure than it is possible to produce it locally. In this case bulk supplies of gas and electricity can be transmitted longer distances than indicated herein without involving the community in an annual charge greater than at present.

This possibility is, in fact, the chief justification for considering bulk supply over long distances as against local production, and would seem to determine whether bulk supply of energy from central producing stations is advantageous over long distances.

Legal Considerations Governing Long-Distance Transmission of Gas.

By H. V. LLOYD-JONES, Barrister at Law.

Authoritative Body: Technical Committee, Fuel Conference, 1928.

[Extract.]

The question of the practicability and the desirability of long-distance or, as it is sometimes referred to, high-pressure transmission or distribution of gas has assumed considerable importance in the last few years. In Germany in particular steps are being taken in this direction which, if successfully completed, would mean the revolutionizing of the means of production and distribution of gas in that country. At a later stage in this paper some reference will be made to the great Ruhr scheme initiated by the General Coal Utilization Company with the object in view of supplying a large number of the centres of population from the surplus gas produced by the coke-ovens of the Ruhr.

In this country the discussion of possibilities in this direction has arisen mainly from dissatisfaction with the present wasteful methods of disposing of coke-oven gas. There would appear to be a growing volume of protest against the restraint imposed by existing legal conditions on the possibility of utilizing coke-oven gas for the purpose of illumination in towns and centres at long distances from the place of production.

This paper is limited to a consideration of the legal difficulties which would confront a scheme in this country for the long-distance transmission of gas from a proposed new centre or from existing coke oven sources. It is clear that there are technical and economic considerations involved in any such project, and that in the result the question would resolve itself into a matter of political policy.

In so far as the statutory undertakings are concerned, the door is shut against a scheme which would involve the production of gas by a private company outside the statutory area, and its transmission over a considerable distance. Further, in view of the fact that of recent years it has been the policy of Parliament not to grant concurrent powers in any area, it would appear that there is little likelihood of a successful appeal to Parliament for the creation of an entirely new form of statutory undertaking to exist side by side and in competition with those which are already in being.

As regards the non-statutory undertakings, there would not appear to be a direct legal impediment to a long-distance scheme; but it has been indicated already in this paper that there are indirect legal obstacles which for practical purposes would prove unsurmountable.

It may be convenient at this stage to make some reference to the great Ruhr scheme which has been proposed in Germany. The scheme which has been proposed by the General Coal Utilization Company, comprising Ruhr coke oven owners, is of recent initiation and has not yet been completed. The object of the scheme is to utilize coke oven gas produced in the Ruhr area for the purpose of transmission to far-lying centres both for industrial and for illumination purposes. Powerful interests are engaged in opposition. In addition to the open hostility of existing undertakings in Germany, the railways are exercising an indirect check by demanding exorbitant sums for rights over land under their control.

It may be noted that the Ruhr scheme is a matter of private enterprise and that it is greatly favoured by the convenient grouping of the coke-ovens both territorially and financially. A convenient summary of the scheme from its technical and economic aspects may be found in the "GAS JOURNAL" for Jan. 18, 1928, p. 144.

POSSIBLE LINES OF CHANGE.

It remains to consider some possible lines along which a change might be effected in the present legal position in order to facilitate the utilization of coke oven gas by means of long-distance transmission. In this paper general suggestions alone can be made. Should any such scheme be mooted, it would become necessary to have recourse to Parliamentary machinery to carry it into effect; and the exact powers demanded and granted would depend upon the objects and aims of the originators and the opposition which in all probability would be offered by parties and interests affected.

For present purposes the following possibilities may be indicated:

(*a*) Parliamentary powers and authorization might be sought for a long-distance scheme, which, if conceded, would bring into being a new kind of statutory undertaking to compete with those already in existence. It has already been indicated that there is little likelihood of a successful issue to such a demand. So much of the existing legislation in the matter of gas would be involved that, short of a general recasting of the law on this subject, and a reshaping of the means of production and distribution, it is almost certain that no considerable statutory change would be made.

(*b*) A general reshaping of the gas supply of the country might be effected by an amending statute similar to the Electricity (Supply) Act of 1926 (16 and 17 Geo. 5 C. 51). Such a transformation would become a matter of national significance. By following the broad lines of the Electricity (Supply) Act, 1926, it would be possible to establish the gas supply of the country on a basis which would provide for the utilization of surplus coke oven gas and its transmission over long distances in the following manner:

1. The coke oven sources would take the place of the generating stations in the Electricity Scheme.
2. A Board similar to the Central Electricity Board would be constituted. The function of the Board would be to undertake the supply of gas.
3. Present undertakers would take their supplies from the

Board unless the Board should see fit to make other arrangements in particular cases.

4. Pumping and storage stations would be established by the Board and would be supplied by long-distance pipes and mains from the coke oven sources. A model for the technical arrangement of such a scheme would be found in the Ruhr scheme in Germany.

Such an amending statute would entail, of course, the repeal of most of the existing law on gas.

In conclusion, it must be repeated that legal difficulties and considerations only have been dealt with in this paper. Before any attempt at new legislation could be made, the very important technical, economic, and political considerations involved would have to be weighed with the greatest care.

Discussion.

Mr. E. C. Evans (National Federation of Iron and Steel Manufacturers) confined his remarks chiefly to the question of distance transmission of gas, with particular reference to conditions in Great Britain. They had in this country, he said, practically five separate producing areas—namely, (1) South Wales, (2) North-East Coast, (3) Midlands (of which the South Yorkshire area was the most important), (4) West Coast, and (5) Scotland. These districts, for the most part, were the natural consuming areas for the coke made; the only iron and steel producing districts outside the coke producing areas being Lincolnshire and Northamptonshire, which drew their supplies chiefly from the Yorkshire and Derbyshire areas. The coke producing centres were mostly highly industrial; and there seemed no reason why these areas should not themselves be in a position to consume for industrial and domestic purposes the coke oven gas available. At first sight, in fact, conditions seemed far more favourable for development of the use of coke oven gas for industrial and domestic supply than in Germany. The natural market for coke made in the Ruhr and Westphalia, for example, apart from the requirements of the Ruhr itself, lay in the Lorraine and Luxemburg districts, which were outside the German frontier; while the natural market for coke oven gas, again excluding the local market in the Ruhr, lay towards the east. It was, therefore, at first sight, rather remarkable that development of coke oven gas supply for town use had not proceeded further in this country than had been the case. There were certainly technical difficulties involved in some producing districts where subsidences, landslides, and other earth movements were liable to occur, but the lucid and valuable paper of Dr. Träenkner on the subject showed that these difficulties could be overcome. It was not, therefore, a question of technique, neither was it a question of cost. Dr. Smith showed in his paper that the cost of transmission of coke oven gas for a distance of 50 miles, which would probably represent typical conditions in this country, was only from 0·3d. to 0·64d. per therm, which was small compared with the price paid by the user to-day for gas. The reasons, therefore, for the slow development in Great Britain of distance gas transmission must be looked for in other directions.

Available Coke Oven Gas.

At the present time, the gas industry in Great Britain was carbonizing nearly 18 million tons of coal per annum, producing nearly 300,000 million c.ft. of gas. The coke oven industry at present was carbonizing nearly 14 million tons; and Mr. Ridley, in his paper before the conference, had pointed out that, after the requirements of the coke oven plants themselves were met, there was available a surplus of over 20,000 million c.ft. of gas per annum suitable for town supply—a quantity small in comparison with the production of the gas industry. There was, therefore, under present conditions, available from coke oven plants only a small fraction of the amount of gas required by gas undertakings; and this possible source of supply had been in the past somewhat neglected by gas engineers.

Many of their coke oven plants were small, and were located in areas which had in the past been peculiarly susceptible to labour disturbances; and with many existing plants no effective guarantees could be given of continuity of supply during strikes. On the other hand, as their present small plants became obsolete, and were replaced by centralized coking installations carbonizing 1000 tons or more a day, if these were of a type which could make use of producer gas or coke oven gas for heating the ovens, and were located at suitable sites, the problem of continuity of supply would not be so serious.

The biggest difficulty was that set out by Mr. Vincent Lloyd-Jones in his paper on the legal considerations involved in any scheme of distance transmission of coke oven gas in this country. They were a remarkable nation. When railways were first started in this country over 100 years ago, all possible legal obstacles were placed in the way of the pioneers; and it was difficult to say what the total expenditure in securing way-leaves in railway construction had meant to the nation. He would like to know how much of the railway rate of 8s. 6d. per ton on coal for a distance of 100 miles was due to legal and Parliamentary charges. They had the same difficulty in connection with electrical supply in this country; and there was no doubt that the high cost of electrical transmission given by Dr. Smith was due to a great extent to legal considerations. They were faced to-day with the same position with regard to coke oven gas, and Mr. Jones' paper clearly pointed to the fact that the difficulties inherent in the present system of legislation were such as would render it practically impossible for any non-statutory company to transmit gas for public supply for any appreciable distance. Mr. Jones, however, had pointed out a possible solution by means of amending legislation similar to the Electricity Supply Act of 1926; and in closing, he (the speaker) would like to suggest to the Fuel and Power Committee that, in considering the possibilities of coke oven gas transmission in the area between the Humber and Liverpool and between Leeds and Birmingham, they should also consider the legal aspects involved in the possibility of instigating legislation which, with the co-operation of the gas and the coke oven industries, would allow of the fullest possible development of the gas supplies that would be made available with the projected modernization of coking plants in this country.

Distribution over Short Distances.

Mr. George Helps, dealing with the cost of the transmission of energy, said he was practically in accord with the figures put forward by Dr. Smith, but he submitted the proposition that the cost of distribution of gas, in the majority of cases, should be negligible. He did not mean that to-day, as gas was produced and distributed, it was negligible, but that it could be made so. At Nuneaton the cost of transmission of gas was regarded as negligible. A 12-in. cast-iron main, one mile long, could be laid to-day for £1750. Assuming an initial pressure of 10 in., and an outlet pressure of 6 in., the capacity of the main for twelve months on full load—8760 hours per year—would be 350 million c.ft. of gas. Allowing an amount of £175 a year—10 p.ct. of the cost of the main—to meet all charges, and assuming that gas of a calorific value of 200 B.Th.U. per c.ft. was being distributed, the cost of distribution per therm would be 0·06d., calculated at the discharge end of the main. It was all very well to calculate the discharge from a straight pipe, however. What would be the discharge of the pipe if, as was the case in practice, there were 20 or 30 branches leading from it? The quantity discharged through its associated branches would all help to reduce the cost of transmission per therm. What the ultimate figure would be he did not know, but he estimated it roughly at about one-tenth the cost of distributing through the straight pipe without branches. From the point of view of horse-power transmitted, a mile of straight pipe supplying gas to an engine would transmit 7 million horse-power per year. Assuming that the potential heat in one ton of coal was 250 therms, the cost of distributing the equivalent of that ton of coal over a distance of a mile, on the figures given, would be 1s. 3d. He advocated the policy of decentralization of gas manufacture, and the transmission of gas over shorter distances. There was no place in this country where it was necessary to supply an area of 20 miles from one gas-works. If, in such an area, several units were erected for feeding the mains, it would be realized more than ever that the cost of gas distribution was negligible. There was a great responsibility resting upon those who threw cold water on schemes which were proposed from time to time for the benefit of the people who could not help themselves.

In Reply to Mr. Helps.

Dr. E. W. Smith pointed out to Mr. Helps that the papers under discussion dealt with the long-distance transmission of power, and not with local distribution of gas within the confines of a local authority; the conditions in the two cases were entirely different. Consequently, though Mr. Helps' contribution would be most useful in another connection, it was quite beside the point of the present discussion. The effect of transmitting a 200 B.Th.U. gas as compared with a 500 B.Th.U. gas, and the corrections for specific gravity, would be to double the cost of distribution on a 100 p.ct. load—and that was a factor to be borne in mind when considering Mr. Helps' figures. The costs of gas transmission, as given in his paper, covered distances of from 5 to 100 miles; the minimum distance being 5 miles. The cost of distribution depended upon the necessary pressure, the volume of gas, and the diameter of the mains; and, with a 100 p.ct. load factor, the cost of distribution through any given main over a distance of one mile would be very considerably reduced. This was all beside the point, however, because no one would consider transmission over a distance of a mile as being long-distance transmission. With regard to the suggested installation of small gas manufacturing units and the elimination of long-distance gas transmission, he said that Mr. Helps was probably not aware—otherwise he would not have raised the point—that the Gas Light and Coke Company had had to remove their gas-works from the centre of London, and concentrate gas manufacture at Beckton, at considerable expense to themselves. The tendency generally was to try to eliminate the nuisance arising from the existence of industrial concerns, including gas-works, in office areas; and it was not often possible to have gas-works within the confines of a city.

Mr. Helps said he estimated that London required fifty gas-works.

Dr. Smith replied that it was recognized that by this means gas could be distributed in the cheapest manner; but it was not allowed, and, therefore, it could not be considered in connection with this discussion.

Long-Distance Problems Not Insuperable.

Mr. H. V. Lloyd-Jones referred to statements made in his paper which might be open to misconstruction. In the first place, he said

he feared he had given the impression that there would be increased difficulty in satisfying the standards of quality of gas under a long-distance scheme as compared with the present system of gas transmission. He did not think it was right to imply, as he appeared to have done, that under a long-distance scheme the difficulties would be increased; because it seemed to him, on re-considering the matter, that, though there was a kind of dual responsibility for the maintenance of the quality of gas, at present coke ovens produced gas and statutory bodies supplied it; the statutory bodies being responsible for the quality. He did not think that under a long-distance scheme the difficulties would necessarily be so greatly increased as to be insuperable. In the second place, with regard to the Electricity Supply Act, 1926, he said that in referring to that Act as a model he did not wish to imply that it was the only possible model on which a long-distance scheme could be framed. He had put it forward as the most obvious and most convenient model; but, of course, if the question of long-distance transmission arose, it would be possible to utilize different schemes, and ultimately it would be a matter of political policy rather than of legal difficulty. Finally, on behalf of the Law, he resented Mr. Evans' suggestion that it was due to feudal relics in their legal system that these difficulties were now in existence. The difficulties, he said, were not feudal; they were inherent in ownership, and if they were to adopt Mr. Evans' suggestion that the present legal system in this country should be abolished, they would have to abolish, not feudal relics, but the whole principle of ownership.

THE GAS INDUSTRY'S ATTITUDE.

Mr. ROBERT MACLAURIN, referring to the paper by Dr. Smith, said he considered it a very clever piece of pleading for the gas industry as against the electrical industry. Dr. Smith would probably have made a good lawyer or politician, but he was not a very safe leader for the gas industry. Dr. Smith had put forward figures showing that the gas industry could distribute gas rather more cheaply than the electrical industry could distribute electricity. The question they were interested in, however, was whether the consumer could get his gas at a lower cost in consequence. A figure of about one-tenth of a penny had been given in the paper as representing the cost per therm of transmitting gas a distance of 5 miles; but from his (Mr. MacLaurin's) experience, the gas industry did not appear to be interested in savings of that order. Many years ago he had put forward to the gas industry a proposal for making cheap gas—a proposal which, if adopted, would have reduced the cost of producing gas by 2d. or 3d. per therm. He had had an interview with the Gas Manager at Glasgow, which had lasted half-an-hour, after which the proposal was turned down. Then he had been recommended to go to the Electricity Department. He had seen Mr. W. W. Lackie (the then Electrical Engineer and Manager at Glasgow), who had brought in Mr. Archibald Page; and together they considered the figures he had put forward. After discussing them for two hours, they had told him that if he could show a saving of one-tenth of a penny in the cost of production of gas for electricity generation it would be of great interest to them. Subsequently the Electricity Department at Glasgow had recommended that the MacLaurin plant should be tried; whereas the Gas Department, which would have made a very much greater total saving thereby, had turned it down. Eventually, however, both parties had united, and had agreed to experiment with the plant. This experience indicated a difference in the outlook of the electricity and the gas industries; and it needed to be emphasized. Those in the former industry were trained as scientists, and were dealing in a scientific manner with their problems; those in the latter were playing around, and, having a monopoly, charged 3d. or 4d. more than they need for their gas, and did not care whether they saved 1d., 2d., or 3d. in the cost of production.

Dr. SMITH pointed out that his figures were prepared in conjunction with the Electricity Commissioners.

Mr. MACLAURIN replied that the figures were perfectly correct. Continuing, he said the MacLaurin process, he believed, could produce gas at about 1d. per therm, of a quality of 240 B.Th.U. per c.ft. The present gas process, as used in the gas-works of the country, produced gas of 500 B.Th.U. per c.ft., at a cost of 3d. or 4d. per therm. The cost of transmitting gas was about 0·1d. per therm. Thus, the cost of producing gas by the MacLaurin plant, and of distributing it, was 1·1d.; or, taking into consideration that the gas was of a calorific value of 240 B.Th.U. per c.ft., the distribution cost would be doubled, for purposes of comparison, so that the cost of manufacture and distribution would be 1¼d. per therm. The cost of producing and distributing vertical retort gas would be 3d. or 4d. *plus* 0·1d. per therm—a total of 3·1d. or 4·1d.—assuming a 100 p.ct. load, as was the case in the electricity industry, but the gas industry had only one-tenth of that load. The cost of distribution depended very largely on demand. Gas which cost 4d. to produce was sold to the consumers at 8d. The trouble was that, because gas was sold at such a high price, the consumers used very little of it. The gas industry would save itself by producing and distributing gas more cheaply; the mains would then be fully utilized. At the present time the average consumer was using something like 100 c.ft. per day, instead of 500 or 1000 c.ft.

LOW-TEMPERATURE GAS.

Col. W. A. BRISTOW remarked that, with regard to the paper by Mr. Lloyd-Jones, in which were set out the legal considerations governing long-distance transmission of gas, he thought it most opportune that a paper of this character should be presented at the conference. They were now, if not at the parting of the ways, at all events at a moment of rapid development in many directions with regard to the national use of fuel. In considering the development of new branches of the fuel industry, care should be taken not only to respect the just rights of those already in the field, but, at the same time, preserve as far as possible the liberty of action of the user. Concerns such as statutory gas companies carried on their business to certain restrictions as to the calorific value, pressure, and purity of the gas; and their freedom as a private enterprise was, in other respects, somewhat trammelled. They even found themselves in the position of being very large ratepayers in a district in which the municipality carried on the rival business of the production of electricity for domestic consumption; and in such cases it was important that in the future, whatever new developments might be taking place, the respective rights of these two bodies should be properly observed, in order that the consumers might not be prejudiced either one way or the other. The gas grid scheme, if properly worked out from a technical point of view, would undoubtedly be of great value to the low-temperature carbonization industry, as it would afford a ready and profitable means of consuming the large quantities of low-temperature gas available; but at the same time he felt that no such development should take place unless the rights of all parties were properly observed. Since reading the paper by Mr. Lloyd-Jones, he had procured copies of the various Gas Acts which bore upon this particular branch of the subject, including the most recent Act of July, 1928. In reading through this Act, the purpose of which was to extend the limits of supply of a large London Gas Company, he was surprised to note in Clause 19 that the Act should not apply to a housing estate erected by a London Borough Council. On referring the matter to a friend connected with this particular Council, he heard a very interesting story, which illuminated very clearly the points he wished to make. It appeared that this Council, when erecting 2000 houses on an estate, under the Government housing scheme, decided that the terms of the tenancy should prohibit the use of gas for lighting purposes; and in the leases a clause was inserted to the effect that the use of gas for this purpose would not be allowed. The decision appeared somewhat remarkable in view of the fact that the Gas Company had offered to lay the mains, pipe the gas to houses, and supply fittings and cooking and heating equipment free of all cost to the Borough Council, and, moreover, with absolutely no proviso whatever as to whether the tenant should use gas or electricity. The tenants of the estate, being in desperate need of homes, had perforce to swallow this clause, but immediately got together and presented a very extensively signed petition to the Borough Council, asking that they might have equal rights with the other ratepayers, and be allowed to choose for themselves whether they would use gas or electricity. The Ministry of Health, being informed of the condition of affairs, gave notice to the Borough Council that they would not be responsible under the Housing Scheme Funds for the extra cost of putting in the wiring into the houses, in view of the offer of the Gas Company; and he assumed that the cost of wiring the houses was thrown on the general rates, so that a ratepayer in one part of the district had the privilege of paying for the installation of the electric light forced upon another ratepayer who did not want it, in the same district.

This raised, in his opinion, a legal point of paramount importance, and one which would have to be very carefully considered when dealing with any developments in the fuel situation which might require legal alterations. It was true that the private owner of a house could, when letting it, make any terms he pleased with the would-be tenant. He might even insist that the tenant should be a total abstainer, or have no children in the house; and if the tenant took on the house, he did so with his eyes open. He personally could foresee, however, enormous difficulties if borough councils or other authorities putting through housing schemes with public money were allowed to treat the houses as their private property, and impose terms upon that part of the ratepayers who inhabited those houses, different from, or more onerous than, those endured by the rest of the ratepayers in their district. He suggested that an extension to the Housing Acts was necessary, and that the extension should establish the fact that the local authorities were not to treat these houses as their private property or to do any act which impaired the legitimate freedom of the tenant. The result of this particular action was as curious as it was lamentable. The tenants, being deprived of gas for cooking, had, in a large number of instances, had recourse to oil stoves; and he was given to understand by those in the oil industry that this part of Woolwich was now one of their best sales districts. As the whole of the oil they used was imported, this constituted another blow at the national fuel industry. He was already at cross purposes with one provincial local authority who had their own gas undertaking. The ratepayers in that locality did not like their gas-works coke, and would not burn it. "Coalite" had been introduced into the district and had displaced some of the small coke trade still existing, and from conversations he had had with the Gas Department it was clear that they had exercised their wits in order to try to devise some scheme by which their ratepayers should be prevented from burning "Coalite" in preference to their own coke. He was not suggesting for one moment that this represented the general attitude of the gas companies on this important question. He merely mentioned it to show that, while in some cases their interests might be opposed, yet he was equally concerned with them, or even with electricity companies, in order to secure legal action which should reserve the rights of the public and pay due regard to the legitimate interests of new or established industries. If gas companies were to be debarred from legitimate expansion by actions such as he had just described, and at the same time attacked in the rear by other concerns having the right to pump gas into their mains, how could they carry out their obligations and continue to submit to the restrictions imposed upon them under the present Acts? He thought the present was a very opportune time for establishing a committee which should investigate the situation with a view to making recommendations as to the nature of the legislation required to deal with future developments, in order that no one section of the community be unjustly treated.

"Waste" Heat Recovery.

By F. J. BAILEY, W. GREGSON, and J. W. REBER.

Authoritative Body: Technical Committee, Fuel Conference, 1928.

[Extract.]

The methods of heat recovery may conveniently be considered in two distinct sections—those methods by which the surplus heat is returned to the process, and those in which it is utilized in secondary processes worked at a lower temperature than that of the primary operation.

In practice, the surplus is recovered by one or other, or in certain cases by a combination, of the following two methods:

(*a*) Regeneration or recuperation—*i.e.*, heating the ingoing air of combustion, or heating gas by the sensible heat in the discharged products of combustion.

(*b*) Steam raising or water heating.

There is a definite practical limit beyond which it is not economical to recover the heat and return it to the process. This limit is largely dependent on the ratio of the volume of waste gas to the volume of air. Where the gaseous fuel is of comparatively high calorific value, such as coke oven or town gas, and therefore the volume of waste gases is only about one-fifth greater than the volume of air, the outgoing products of combustion can be reduced to low temperatures by suitable regenerators and the heat transferred to the relatively large volume of air. On the other hand, on producer gas fired furnaces, where, in addition to the fact that the volume of air is only about one-half that of the products of combustion, the producer gas itself as delivered to the furnace is at high temperature, the limits of heat recovery are very definitely fixed. In fact, in such a case, it is not possible for the ingoing air to take up more than about 50 p.ct. of the heat in the products of combustion.

To utilize the remainder of the surplus heat it is necessary to consider some low-temperature operation such as steam raising or water heating. It is often argued, even when producer gas is the heating medium, that low "waste" gas temperatures are obtained with regenerators, and no further economy is possible. Instances are cited where "waste" gas temperatures at the outlet of the regenerators are some 300° C.

The answer is, invariably, that the low temperature is due to infiltration of air, either at or near the regenerators, or in the flue system itself. *The only criterion of furnace efficiency is the amount of fuel used per unit of primary product.* Outlet "waste" gas temperatures require to be accompanied by gas analyses sufficient to compute the excess air content before a decision as to whether further fuel economy is possible.

RECUPERATORS.

In a recuperator the hot products of combustion pass continuously along one side of a partition wall, and the medium to be heated, either air or gas, passes continuously along the other side. A recuperator is therefore a continuous heat interchanger. The separating wall, through which the heat is transmitted mainly by conduction, is generally built up from bricks, tiles, or special hollow blocks, made of refractory material. In recent years metallic tubes have come into use for this purpose. The outstanding features of an ideal recuperator are:

1. Compact construction.
2. The material employed should be non-porous and must possess a high thermal conductivity.
3. The relationship of heating surface to the weight of the gaseous medium flowing through the tubes should be high, involving narrow flues.
4. High velocity of gases in flues, which should be easily accessible for cleaning.
5. To obtain rapid heat transmission, the partition walls should be comparatively thin, but of sufficient mechanical strength to prevent leakage through joints and cracks caused by stresses due to unavoidable expansion.

Narrow flues, though very suitable from a heat transmission point of view, have a higher frictional loss, requiring an increased chimney pull, which again facilitates leakage and dilution. Special attention to the flue areas must be given if the combustion products contain a considerable amount of flue dust. Metal recuperators (an ideal construction) have been adopted largely for low-temperature work, especially for pre-heating the combustion air for boiler firing. For higher temperatures, heat-resisting metals, such as calorized iron, chrome steels, and nickel-chromium alloys, are now being used. The high initial cost of high-temperature metal recuperators, and their rapid deterioration due to the presence of sulphur compounds in the products of combustion, have prevented adoption on a large scale.

There are three types of recuperators, the parallel-flow, the counter-flow, and the cross-flow types. For materials of relatively low thermal conductivity, such as refractory material, the counter-flow type of recuperator gives the best results.

The maximum theoretical proportion of the sensible heat entering the recuperator which can be recovered by pre-heating the combustion air is approximately 40 to 45 p.ct., and is, in actual practice, only 30 to 40 p.ct.

The required heating surface of a recuperator for any specified case depends on the available temperature of the combustion products and the extent of the pre-heat, the thickness of the heat transmitting walls, and the heat conductivity of the material, as well as on the general design of the recuperator. The heating surface can be calculated from the formula:

$$A = \frac{Q \times d}{k \times (\theta_1 - \theta_2) \times t}$$

where A = heating surface.
Q = quantity of heat passing through the wall.
t = duration.
θ_1 = mean temperature of heating fluid.
θ_2 = mean temperature of pre-heated fluid.
d = thickness of wall.
k = coefficient of thermal conductivity of the material.

If k is expressed in C.G.S. units, it is the number of gram-calories transmitted per second from one face of a cube of edge 1 cm. to the opposite face per 1° C. temperature difference of the two surfaces. Expressed in the usual English units of B.Th.U. per hour per sq. ft. per 1 in. per 1° Fahr., it represents the amount of heat transmitted per hour per one square foot area of a wall of 1 in. thick per 1° Fahr.

REGENERATORS.

The efficiency of heat transmission in regenerators depends to a large extent on the time contact, on the area of the exposed heat-emitting and heat-absorbing surface, on the specific heat of the material, and on the capacity of the heat conductivity of the chequers, as well as on the correct proportion between the weight of chequer brickwork and that of the heat-emitting and heat-absorbing media. In well-designed regenerators the temperature difference of waste gases and pre-heated air during one reversal period should not exceed 80° to 100° Fahr.

The usual type of chequer work consists of either normal bricks or special shapes of 2½ in. square. Recently, new types of regenerator filling have been introduced, such as spiral and hollow bricks, which appear to give very good results.

COMPARISON OF METHODS OF AIR PRE-HEATING.

Each of these two types of heat recovery has its advantages and disadvantages. The adoption of either depends to a very great extent on the heat requirements of the specific furnace. The recuperator, though not so efficient as the regenerator, is a continuous heat interchanger, whereas regenerators work intermittently. The former, requiring practically no attention, is more suitable for smaller furnaces, especially in cases where the combustion temperatures required do not exceed 2500° Fahr. (1360° C.). The recuperators built in refractory material require more space than regenerators, and are more difficult and costly to repair. Operating difficulties caused by flue dust collection, cracks, leakages, and dilution, can never be entirely eliminated in recuperators, even when the utmost care is taken in their design and construction.

CARBONIZING PLANTS.

Modern forms of coke ovens are almost without exception of the regenerative type, and waste-heat recovery is only applicable to the older types of non-regenerative ovens which are rapidly falling into disuse. In the gas industry, however, where producer gas is used for heating the retorts, the utilization of waste heat for steam raising is now established practice. The development in this industry of methods of waste-heat recovery, which has taken place only since the war, has depended on the disposal of coke breeze. In the absence of a satisfactory market for this product, it perforce had to be used under the works boilers. The steam requirements of the works thus being satisfied, there was no call for waste-heat recovery as steam.

During the last decade, developments have taken place in the use of coke breeze in ordinary boilers and also in the manufacture of breeze blocks for the building trade. Thus, markets for this gas-works bye-products have been opened up. The adoption of the recovery of waste-heat as steam has been further accelerated by the increasing demands for steam for process work and for power to replace operations originally performed by hand.

Coal gas plants can be broadly divided into two main types, continuous settings and settings working intermittently—the former being only of the vertical type, whereas the latter embodies verticals, and inclined and horizontal chambers or retorts. From the standpoint of fuel consumption, the chief difference lies in the fact that in settings working intermittently the coke is discharged at high temperatures, and some

25 p.ct. of the total heat supplied to the setting appears as sensible heat in the coke. On continuous vertical retorts, the coke is cooled by the incoming steam for water gas production, and in some cases is further cooled by the circulation of secondary combustion air round the bottom of the retort. Whereas in horizontal settings, in order to supply the extra heat absorbed by the hot coke and still obtain a reasonable fuel consumption, it is necessary to maintain pre-heating of secondary air by means of waste gases, builders of continuous vertical retorts have abandoned this form of waste-heat recovery, and thus have available for steam raising practically the whole of the heat in the waste gases leaving the combustion chambers. Hence, in general practice, the continuous vertical retort gives considerably higher steam yields.

Of course, where a system of dry cooling of the coke from intermittent plants is introduced, in which the sensible heat of the coke is recovered as steam, the total yield of steam—that is, from waste gases *plus* that from hot coke—is practically the equivalent of the yield from modern continuous vertical retorts.

Water gas plants are a separate type of gas-making plant to which waste-heat boilers are applied; as a large amount of heat escapes to atmosphere during the blow period. In modern practice some 80 to 100 lbs. of steam per 1000 c.ft. of water gas are available, and this quantity is sufficient to make the plant self-supporting in the matter of steam requirements. The use of the exhaust steam from the blower turbine is a further economy in this direction, though it is more difficult to arrange with a single unit than with a battery of plants, unless an accumulator is provided.

Gas Engines.

The application of waste-heat boilers to gas engines goes back almost to the early days of the engine itself, especially in the case of large blast furnace gas engines. In general practice 2 to 2·5 lbs. of steam from and at 212° Fahr. per B.H.P. per hour is available. As in the case of steel works and gas-works boilers, if the gas contains sulphur compounds, it is undesirable to add feed-water heaters to increase the thermal efficiency; but in the case of blast furnace gas it is possible to work to a very much lower outlet boiler temperature without meeting trouble, under which conditions the yields of steam are materially enhanced.

"Waste" Heat Boiler Practice.

The success of water-tube boilers as rapid transmitters of heat when fired with solid and gaseous fuels naturally led to their adoption for absorbing the sensible heat from waste furnace gases; and waste-heat recovery was first effectively carried out on a considerable scale on this type. It is necessary, however, to consider waste-heat recovery problems under two separate headings:

(*a*) Problems in which the heat absorption conditions closely approximate to those appertaining to solid fuel-firing practice.

(*b*) Problems involving the use of low-grade waste gases where conditions are entirely different.

The real key to the situation is the proportion of heat transmitted to the boiler tubes by radiation. The water-tube boiler is pre-eminently a radiant heat absorber. In fact, under solid fuel-fired conditions some 70 p.ct. of the total evaporation occurs through radiation in the rows of tubes near the fire, while beyond this zone the evaporation per unit of heating surface falls rapidly, and in general practice the economizer and air heater, if installed, deals only with the "tail" of the gases.

With low-grade gases, the radiant heating effect is practically negligible; and all precautions must be taken to obtain the best possible heat interchange by actual physical contact between the gas particles and the walls of the heating surface. The water-tube boiler is nothing like as well suited to this type of heat transmission as the fire-tube boiler, and, furthermore, the latter type is more satisfactory for the adoption of high gas velocities, thereby setting up turbulence of gas flow with consequential increased rate of heat transference.

It would appear, therefore, that when handling high grade gases, the water-tube boiler is inherently suitable, but for the bulk of the problems met with in waste-heat recovery, especially on regenerative furnaces, the fire-tube boiler holds an unchallengeable field. The authors place the dividing line at waste gas temperatures of about 1000° C.

In addition to its suitability for high velocity of gas flow without superimposing excessive resistance to the gas stream—as would be set up with a water-tube boiler with closely spaced tubes and many passes to admit of intensified contact heating—the fire-tube boiler takes up less space and avoids the necessity for an outer casing, which is very liable to permit in-leakage of air. Again, it is much easier to arrange the cleaning of the "gas side" of the heating surface of a fire-tube boiler. With regard to the "water side" of the tubes, reasonably soft water is essential for good results—a fact well realized nowadays in all boiler practice.

General Report on Section Q: Low-Temperature Carbonization.

By F. S. TOWNEND.

This Section met on Tuesday, Oct. 2, under the presidency of M. GUILLAUME, Inspector General of Mines, France.

The three contributions which form Section Q are the subject of this General Report. They are:

(*a*) "Possibilities of Co-Ordination between Coal Processing and the Production of Electricity" (Germany) by Dr. Ing. P. Rosin.

(*b*) "Low-Temperature Carbonization" (Great Britain), by Dr. C. H. Lander and Dr. F. S. Sinnatt.

(*c*) "The Present State of Low-Temperature Carbonization in Germany" (Germany), by Dr. R. Heinze.

Present Position of Low-Temperature Carbonization in Germany and Great Britain.

In Central Germany, low-temperature carbonization of brown coal has been practised for nearly eighty years. The ovens may be of the externally heated or internally heated types. In the latter class heated gases are used to convey the heat into the charge. In certain cases the ovens are fed with raw brown coal, but in other types the brown coal is treated in the form of ovoids or briquettes made from dried brown coal.

For the low-temperature treatment of true coals, of the many forms of apparatus introduced by reason of the oil shortage during and after the war, only those have survived which are capable of providing a saleable coke. There appears to be only one type of rotary retort still in operation. In later years, forms of revolving ovens have been designed in which the coal is carbonized in annular cells under pressure, so that a large coke of dense, even structure is produced.

Oil shale is also being treated by low-temperature processes, particularly at Messel, near Darmstadt. Mention may also be made of the Delleskamp process for increasing the calorific value and fixed carbon content of low-grade fuels, such as bhown coal, lignite, peat, &c., by reduction of the contents of carbon dioxide and water. It is claimed that, in spite of the introduction of the hydrogenation of coal, low-temperature carbonization will be more alive than ever.

In England, with the exception of an installation for treating cannel, the plants now in operation are all treating ordinary bituminous coals with the main object of producing a solid smokeless fuel for domestic purposes. Dr. Lander and Dr. Sinnatt, in their paper on "Low-Temperature Carbonization," state that at present there are some sixteen plants which are capable of dealing with 10 tons or more of coal per day. The results obtained in tests on eleven of these plants are given, seven of which have been tested by the Fuel Research Board. The majority of the plants give a combined yield of from 18 to 22 gallons of tar and spirit washed from the gas. In the case of the plant treating cannel, yields of 50·2 gallons of tar and 3·7 gallons of spirit are reported. The yields of gas vary very greatly, depending on the method of heating the retorts.

Special Factors Relating to British Conditions.

Special attention is drawn to the effect that widespread development of the carbonization of small coal in low-temperature processes will have on the price of coal. It is pointed out that "if the household market for the lump coal is filled by fuels made from small coal—whether coal gas, gas coke, oven coke, or low-temperature coke—the natural result will be an increase in the price of the small coal until it bears its full mining cost." "On the other hand, the price at which really large quantities of smokeless fuel will appeal to the public will probably be about that of household coal." Commercial success of low-temperature carbonization depends largely on whether the plants as regards cost of operation can work between these limits together with the credit to be obtained from the sale of tar.

In this connection the important statement is made that "investigations of low-temperature tar do not appear at this stage to have revealed any special feature likely to raise its commercial value above that of high-temperature tar." Further, it is pointed out that from year to year, and from one part of the country to another, the value of tar varies very greatly. In 1926 the variation was from 2·8d. to 8d., with an average

of 4·6d. for London. The authors state that, if the amount produced in a particular district or in the country generally is such as to saturate the requirements for special products derived from tar, the sole method of utilizing the surplus will be as fuel oil. The value of this is given at the present time as 3d. to 3½d. per gallon.

As a means of enriching ordinary town gas, the gas from low-temperature processes is not of primary importance to the gas industry. Special uses may be found for it, as it is not greatly inferior to gas produced from the cracking of oils. It has been suggested that by compression a portion of the unsaturated and of the saturated hydrocarbons can be condensed for use as a substitute for acetylene for welding processes. The unsaturated hydrocarbons may be recovered as alcohols or converted into glycols for use as substitutes for glycerine. Explosives can be obtained from nitrated unsaturated hydrocarbons.

Low-temperature coke in lump form has great advantages over raw coal for the open domestic grate so widely used in Great Britain. It has been shown that the householder does not require to burn the same weight of coke as of coal in order to obtain the same comfort effect.

It is emphasized that high moisture and ash neutralize some of the advantages of coke; and it will be necessary to use good-quality coal for coking. It is stated that "coking, whether high or low temperature, cannot be regarded as a means of producing a satisfactory smokeless domestic fuel from coals which owe their low price to a high ash content."

Figures are given in connection with successful trials of low-temperature coke for use in gas producers for motor traction. Over a distance of 30 miles the consumption of a lorry of 6 ton over-all weight was 2·6 lbs. of low-temperature coke per mile. A development in this direction would make Great Britain less dependent on outside sources of motor fuel.

The possibilities of pulverized low-temperature coke for boilers and furnaces are receiving attention. The limiting factor is the temperature of the furnace, which must be above about 1000° C. Wear and tear of the pulverizer is claimed to be slightly greater than with coal.

Special attention is called to the question of the treatment of the aqueous distillate. With one or two exceptions, the liquor is practically worthless as regards ammonia content. The sulphur and other compounds present make it impossible to run such liquors into the sewers or streams, and means must be discovered to render them innocuous.

Reviewing the possible applications of low-temperature carbonization in Great Britain, Dr. Lander and Dr. Sinnatt make the following points. The gas industry could provide a ready market for the rich gas from externally heated retorts. The lower grade gas from internally heated retorts could also be used to replace the producer gas normally used for heating high-temperature plants. The gas companies having marketing arrangements for coke could also dispose profitably the solid smokeless fuel. It is to be specially noted that, if the 40 million tons of coke used in Great Britain for domestic purposes were replaced by solid smokeless fuel, the production of rich gas would be so great it would be possible to deal with this only through the gas industry. The Gas Light and Coke Company are engaged in a commercial experiment to provide data for a reliable forecast of the economic position of such plants.

The general conclusion which C. H. Lander and F. S. Sinnatt reach is that, "while from the technical aspect low-temperature carbonization plants can be worked at a price to produce coke, tar, and gas in adequate quantity and quality, we still await the results of long period commercial operation, selling the products on the open market, and producing actual profits to shareholders." "There are undoubtedly local conditions in various parts of the world under which a plant can be expected to be a commercial success; but to what degree low-temperature carbonization may develop as a real factor in national fuel utilization, time only can tell."

Co-Ordination with Electricity Generation.

While in Great Britain coal processing is generally considered as an independent operation, the primary products—namely, coke, tar, and gas—being sold in the open market, there are projects for operating low-temperature carbonization plants in conjunction with electricity generation. Dr. P. Rosin, in his paper on "The Possibilities of Co-Ordination between Coal Processing and the Production of Electricity," deals in much detail with the underlying principles of combined operation and its practice so far as it is developed in Germany. It will be necessary to consult the original paper to obtain a clear idea of the details involved in co-ordinating coal processing with power production; but the salient points may be brought out in this General Report.

Four principles are laid down as governing all co-ordination. First, co-ordination must lead to a lowering of the cost of the main product as compared with that in independent works. Secondly, one of the processes to be co-ordinated must be dominant and the others subordinated to it. Thirdly, as many as possible of the main, intermediate, and bye-products must be used interdependently; and, lastly, the economic weaknesses of the individual processes must be neutralized as far as possible. In applying these principles to the production of electricity, it is clear that co-ordination must lead to a cheaper kilowatt hour. The demand for current is the dominating factor; and the processes co-ordinated with electricity generation must facilitate the supply of peak load requirements and raise the average load.

There are several examples in Germany of the combination of a brown coal briquetting plant with electricity generation. In this case, the lignite for the briquetting works is dried by steam or flue gases. The dust is screened out and used in one part of the boiler plant, while the other is fired by crude lignite.

From a consideration of the values of the products from various forms of thermo-chemical coal processing such as low-temperature carbonization, high-temperature carbonization, gasification, &c., P. Rosin concludes that the only forms which can be economically co-ordinated with electric power production are:

(*a*) Low-temperature carbonization of lignites.

(*b*) Low-temperature carbonization of *non-coking* coals. The restriction of co-ordination of low-temperature to non-coking coals is due to the fact that the co-ordinated process must always compete with the burning of raw coal, and that low-temperature coke from coking coals will always be able to command a better price if sold for household purposes than could possibly be paid by the electricity works. In consequence, the combination of low-temperature carbonization with electric power generation is essentially confined to lignite, and there are now power stations in Germany operating under these conditions.

The detailed arrangements of such plant are subject to variation. The lignite semi-coke is used as fuel in the boilers of the electric power station. The gas can be used for heating the ovens, but is better employed in supplying the community or other industries. The tar is sold. Fluctuations in the demand for electricity are taken up by storage bunkers for the lignite semi-coke. A very interesting suggestion is put forward in Dr. Rosin's paper, in which the generators would work at constant load, the surplus over demand being used in an intermittently operating electric carbonization process.

It is obvious that the economics of the co-ordination between low-temperature carbonization and electric generation depend largely on the amount of tar for sale; and the relation between the cost of lignite semi-coke and raw lignite for varying yields of tar is given in the form of curves.

Reviewing the information given in this General Report, it may be said that low-temperature carbonization in Germany is largely confined to the treatment of lignites, and this has successfully been combined with the production of electricity. In Great Britain, low-temperature carbonization is concerned mainly with the production of a solid smokeless fuel for domestic purposes. There are several forms of apparatus receiving semi-commercial investigation, but their economic success either as independent plants or in association with established industries is still to be proved.

Discussion.

Dr. F. S. Sinnatt (Vice-Chairman) said that low-temperature carbonization was just passing—some people liked to say it had passed—to the stage of commercial development; and in the eyes of the public it had very great attractions, because it offered a solution of two problems—the supply of a fuel for use for all kinds of domestic purposes, and the removal of the smoke nuisance, and it was an obvious way in which a supply of oil could be produced from home sources. In commending the paper by Dr. Rosin as one meriting very close consideration, he said he was surprised that no mention was made in it of the carbonization of coal at low temperatures and the hydrogenation of the liquid portion of it. It was stated in Dr. Rosin's paper that the chief value of brown coal lay in the tar obtained, and that in 1926 brown coal containing 55 p.ct. of moisture had yielded an average of 7·6 p.ct. of tar, or roughly 17 gallons per ton. On a dry basis, said Dr. Sinnatt, this worked out at 17 p.ct. of the brown coal, or roughly 38 gallons per ton. The lowest economic limit was stated to be 14 p.ct.—presumably on the dry basis—or roughly 31 gallons. It was interesting to bear in mind the values obtained by the low-temperature carbonization of bituminous coals. A figure of between 15 and 20 gallons was a reasonable value to obtain from English coals. Some of the isolated remarks in the paper, said Dr. Sinnatt, were interesting as showing that the demand for brown coal and semi-coke for domestic purposes was not increasing. In fact, the sale was decreasing. From the paper by Dr. Lander and himself, said Dr. Sinnatt, it was clear that there were in this country seventeen processes in a state of development, and he added another three, making a total of twenty. Of these, seven had undergone the test which the Department of Scientific and Industrial Research was ready to carry out at the Government expense; and in every case the claims of those responsible for the plants had been fulfilled. They in this country tended

to be rather too modest, but he believed it was not unfair to say that in connection with the development of low-temperature carbonization Great Britain was in advance of other countries. In a paper by Prof. J. W. Cobb, before Section H of the Conference, dealing with gas manufacture, it was pointed out that low-temperature carbonization was not the only method of producing a fuel suitable for domestic purposes, but that it could be done by carbonizing at a high temperature, provided the coal received some special treatment. Associated with this fact they could not ignore that in vertical retorts the yield of oil could be increased by steaming until it became as high as that produced by low-temperature carbonization—*i.e.*, up to 19 gallons per ton of coal carbonized. Finally, Dr. Sinnatt urged that the occasion was not one for false modesty. If any speakers had processes to describe, they should describe them in broad terms, so that the world might know what Great Britain was doing.

Treatment of Coal for Oils.

Mr. R. H. Crozier said that the justification for the low-temperature industry would be the dividends it earned—dividends which were now within measurable distance of attainment. The low-temperature carbonization industry, by virtue of its bearing upon questions of power production, coal output, and oil supplies, was essentially a key industry; and the measure of success which attended the various efforts now being made to establish coal distillation as a profitable commercial proposition would be reflected by an increase in the prosperity of practically every other industry in this country. Examining some of the considerations influencing the problems from the point of view of low-temperature processes in this country, he said there was mined in Great Britain approximately 250 million tons of coal each year. Though the bulk of this was classified as bituminous coal, it consisted of materials widely different in their chemical composition and physical structure, and, more particularly, differing vastly in their behaviour under heat treatment. Many coals, such as those from Durham, Kent, certain seams in Northumberland, Yorkshire, Wales, &c., passed through a phase of liquefaction, and the separate pieces coalesced completely on heat treatment. Others exhibited only a slight tendency to coalesce, while in many the coalescing tendency was completely absent. In considering the question of distillation, therefore, they must provide for the extreme differences in technical behaviour; and to refer, as was commonly done, to *the* low-temperature process for coal treatment was about as illogical and misleading as it would be to suggest that one metallurgical process would be equally suitable for the treatment of all ores. Mr. Crozier discussed the properties of the different types of coal from the point of view of carbonization, and concluded that obviously the sphere offering the greatest financial, industrial, and communal advantages for the development of the low-temperature distillation industry in Great Britain lay in the treatment of simple "free-retorting" coals, the present mode of consumption of which—*i.e.*, burning in the raw state—was little short of an economic scandal. The most cursory examination of the problem from the point of view of establishing the industry on a scale commensurate with the nation's need indicated clearly that the retorts for the distillation of the coal must be of large unit capacity, simple in construction, foolproof in operation, of low capital and operating cost, and capable of working continuously from one year's end to another. The late Sir George Beilby had estimated that the capitalization involved in establishing the industry in England would be approximately £1 per ton annual throughput. Since that statement was made, however, much progress had been effected in the art of coal distillation; and at least one process fulfilling the considerations he (Mr. Crozier) outlined above had been developed which would permit of the industry being established on a capitalization basis of considerably less than £1 per ton annual throughput. By way of comparison with kindred industries, he said the capital engaged in the coke oven industry was over £2 per ton annual throughput, and in the British gas industry there was engaged a capital of nearly £9 per ton annual throughput. It was evident, therefore, that in comparison with the gas and coke oven industries the capital required to establish the new coal distillation industry was comparatively small. It was evident that any serious decrease in the United States oil production would be quickly reflected by a shortage and an increased price of oil products in Britain. They had within British territories ample supplies of raw materials from which the bulk of their oil requirements might be extracted by distillation. The average yield from such materials, however, would be considerably under one barrel of oil per ton. It was evident, therefore, that to make good any considerable percentage of our present consumption would involve the treatment of millions of tons of coals or oil shales every year and the creation of a new industry of unprecedented magnitude, the development of which must be undertaken without delay if they were to be in a position to meet the inevitable oil shortage when it occurred.

Primary Tar.

Mr. Harald Nielsen disagreed entirely and fundamentally with the statement in the paper by Dr. Lander and Dr. Sinnatt that "investigations of low-temperature tar do not appear at this stage to have revealed any special feature likely to raise its commercial value above that of high-temperature tar." The Fuel Research Board, he said, were dealing with a product which had been more or less cracked. It was not a primary product, and consequently he could understand the remarks of Dr. Sinnatt as to the possibility of gas-works vertical retorts producing fuel oil. Work carried out by the group with which he (Mr. Nielsen) was associated, in examining low-temperature tar obtained from the Fuel Research Board and high-temperature tar made by steaming in vertical retorts, showed that there was a great similarity between the two, but when it came to the production of an uncracked primary product, it was another matter.

Mr. G. Helps (Nuneaton Gas Company), who remarked he was a user of one process of low-temperature carbonization, emphasized that, if the low-temperature process be used in gas-works instead of the present processes, there would be a considerable increase in the quantity of coal raised. Discussing the differences between internal and external heating, he said it was madness to put coal into a retort with 12 in. or 14 in. of brickwork outside it, and then to apply heat to the outside brickwork and allow it to endeavour to get through and carbonize the coal. In addition to this, they connected to the flue by which they introduced the heat to the retort a chimney 200 or 300 ft. high, to carry away the heat, and then wondered why they sold gas at a price equivalent to £8 or £9 per ton of coal, heat for heat, when it could be sold for £2 or £3. There could be no question as to which process any sensible man should adopt. With internal heating, every piece of coal put into the retort was used to produce sufficient heat to carbonize it. There was only one place for solid fuel, and that was the gas-works, so that it could be gasified. Low-grade gas would be the salvation of this country.

Allowances for Improvements.

Mr. P. C. Pope (Secretary of the Institute of Fuel), who emphasized that the views he expressed were his own personal views, and not those of the Institute, called attention to one important, but much neglected, commercial aspect of low-temperature carbonization which needed very serious consideration before inviting the public to invest their money in plants of this kind—namely, the heavy burden on the debit side of the balance-sheet due to depreciation and obsolescence of plant, a reasonable reserve fund, and the dividend naturally expected by investors. He believed most people who had followed closely the varying fortunes of the many projected and the few operating low-temperature plants in this country for dealing with bituminous coal would readily agree that any plant designed and put into operation to-day would probably be obsolete in seven or eight years, due to improvements in design and the greater economy in operating costs which naturally would be the outcome of a few years' experience of large-scale working. Thus, it would be necessary to write-off an annual sum equal to 15 p.ct. of the total capital cost of the plant. A further annual amount of at least 5 p.ct. per annum must be allocated to a reserve fund, and the holders of such speculative investments as low-temperature carbonization shares would expect to receive annual dividends of at least 10 p.ct. This meant that the plant must yield a cash margin of at least 30 p.ct. on its capital cost, after paying all operating, maintenance, supervision, and sales charges, as well as the cost of the raw coal treated. A plant for carbonizing 500 tons of coal per day and converting it into semi-coke, crude tar, crude spirit, and unpurified gas, but not distilling or refining any of its liquid or gaseous products, naturally varied as to capital cost over a very wide range, according to design. Various estimates given to him for such a plant delivered and erected on a site provided ranged from £75,000 to £180,000. No plant of that description could be expected to operate at full output every day of the year. It must be shut down periodically for cleaning, overhaul, and repairs; in addition to which, market fluctuations in the demand for its saleable products would necessitate variation in output. Therefore, it might be assumed that the annual throughput of coal in a 500 tons per day plant would not exceed 150,000 tons. If, therefore, the capital cost of the plant were £70,000, the plant would have to stand a charge, in addition to raw material, operating and other costs, of £21,000 per annum, or 2s. 9¼d. per ton of coal treated. Should the plant cost £180,000, the annual amount to be debited to capital charge would be £54,000, or 7s. 2¼d. per ton, which was a very large amount to expect to obtain from a ton of coal on top of all other costs by merely converting it into other forms of heat-producing materials of no greater calorific value than the original. Furthermore, several hypothetical profit and loss accounts he had seen, compiled for the information of prospective investors, were based on present-day prices of fine slacks; and no account had been taken of the inevitable rise which must take place in the market price of these small coals when many low-temperature plants of large size were operating in the country. The sale price of the semi-coke from plants designed to produce lump coke for the domestic grate had been taken in these accounts as equal to, or higher than, the present market price of house coal. This was surely a false hope, because the price of lump coal must inevitably fall as the demand for it decreased. At the same time, Mr. Pope said that there was no greater optimist than he as to the ultimate commercial success of low-temperature carbonization; but it was no use living in a fool's paradise.

Colonel L. P. Wineby, M.P., described a process with which he was connected, and which had special features. In this process an internally-heated vertical retort was used. Part of the gases of distillation was returned to the top of the retort, and burned in a restricted volume of air, so that there was no free oxygen to affect the combustion of the charge. The gases were all drawn downwards, and out from the bottom of the retort. A zone of distillation was set up at the top, which gradually passed downwards through the whole charge, leaving the retort full of smokeless fuel. One of the features was that the products of distillation were never subjected to secondary decomposition, seeing that they were drawn away at once from the point of greatest heat. The process was applicable equally to lignites and coal. The main feature of it was that there were no working parts. Capital cost and depreciation and maintenance charges were low. The smokeless fuel obtained was of good quality, and was in lump form. Of the charge, 70 p.ct. was produced as smokeless fuel, and there was an 85 p.ct. recovery of the oil, according to the theoretical assay. The process was very simple. The stage reached so far was the provision of a test plant to carbonize about 400 lbs. of coal. All types of coal had been tried, and there had been no difficulty with a plastic stage.

The MacLaurin Plant.

Mr. R. MacLaurin, commenting on Mr. Pope's remarks, said that the MacLaurin plant was simply an elongated producer, and depreciation charges were very much lower than those of any existing types of producer. As these latter processes had been working for half-a-century, he saw no reason for imagining that it was necessary

to write down very heavy depreciation costs in respect of a producer that was working under more favourable conditions. It was very difficult to simplify the present-day process. This had been at work in Glasgow since 1925, and there had been no alterations to the producers themselves, though there had been to the accessories; but such accessories had been well known for many years. He contended that in the MacLaurin plant gas could be made very much more cheaply than in an ordinary producer, in view of the value of the oil and the smokeless fuel produced; and the gas was of very much better quality than that from an ordinary producer, because it contained from 10 to 12 p.ct. of methane, and, therefore, was admirably suited for use in brickworks and steelworks, and other works requiring high temperatures. With regard to the use of low-temperature carbonization in electricity works, he pointed out that what was required there was steam raising, and the lowest use to which gas could be put was steam raising. The Conference, he suggested, was on the wrong lines in considering low-temperature carbonization in connection with steam raising. Gas was being produced normally in vertical retorts, he continued, at from 3d. to 5d. per therm. It could be produced at Nuneaton at less than 1½d., even when dealing with only 15 tons of coal per day. The labour involved was that of one man. The power was 24 KW. per day, practically 1½ KW. per ton of coal. The steam was from 250 to 300 lbs., and the depreciation charges were extremely low. Referring to Dr. Lander's reference to coking index, he said that at Nuneaton they were dealing with Warwickshire coals having a coking index of only 4, and that produced a remarkably firm coke when dealt with in the MacLaurin plant. They were actually handling singles successfully.

HYDROGENATION.

Mr. H. VAN HETTINGA TROMP (Holland) expressed the view that the low-temperature process would never be a success so long as the coal yielded large amounts of tar acids, with which one could do very little. Acid tars could be treated by hydrogenation, but that was another process, and he believed it was one which would have a very great future.

LOOSE TALK ABOUT "L.-T." CARBONIZATION.

Mr. JOHN ROBERTS expressed the view—which, he said, was quite personal, and had no official authority behind it—that some of the low-temperature carbonization processes would prove successful. The MacLaurin process had already proved successful to a certain extent. There was a good deal of loose talk, however, with regard to low-temperature processes. There had been brought to the notice of the conference a statement to the effect that engineers and chemists were unanimously of the opinion that low-temperature carbonization was the only method by which they would be able to produce a readily ignited smokeless fuel. He fancied that he could see the handwriting of an individual who had been saying the same thing for twenty years, but had not yet delivered the goods. A point to be borne in mind was that, though a very good fuel, and one which was always to be preferred to raw coal, could be made under low-temperature conditions, the advantage which the low-temperature processes had formerly in that matter had definitely been lost, because it had been proved that a fuel which would serve the same purpose could be produced under high-temperature conditions. He did not accept the view that low-temperature carbonization was going to lead the van in this matter. There were two very old horses who had been in the shafts for a number of years—the coke oven industry and the gas industry—and once these two old horses began to pull in double harness, a great deal more rapid progress would be made. It might be that they would use the low-temperature horse in chains; but if the latter did not work hard in chains, he (Mr. Roberts) was inclined to think that the high-temperature industry would simply hitch him up. There was room for co-operation between the two. As an example of co-operation, he referred to the practice in Germany, in connection with the "K.S.G." system, in which coal was carbonized at a low temperature in a rotary retort, and the fines from the process were returned to the coke ovens to be blended with coal for the manufacture of metallurgical coke. This was successful; and whereas it had been necessary formerly to stamp the charges for these old ovens, stamping had now been done away with. Finally, he mentioned a system of making smokeless fuel at high temperature, an article in regard to which had been published in the "GAS JOURNAL" recently.

WORK OF THE GAS LIGHT AND COKE COMPANY.

Col. N. THWAITES remarked that Dr. Lander seemed to be doubtful as to whether the oil and tars produced by the low-temperature process could compete with crude petroleum. He believed it was a fact, however, that to-day a very much higher price was obtained for low-temperature oil; the price, he believed, was over 100s. per ton, whereas that obtained for crude petroleum was something like 70s. It was gratifying to discover, from reading the papers by the experts from the Fuel Research Board, a spirit of optimism which was not manifest two or three years ago. The optimists who had tried to bring low-temperature carbonization to a state of commercial possibility were now being supported by persons who were at least inclined to be pessimistic and to some extent apathetic. He was rather impressed by the discovery that the Gas Light and Coke Company were now experimenting—at the taxpayers' expense, he understood—in the matter of low-temperature carbonization, and particularly in regard to gas. Naturally, the gas companies, and particularly the Gas Light and Coke Company, had not been helpful in the past. It was rather like asking a butcher to recommend a vegetarian diet. He only hoped that by this time the instruction which had been given by a great many enthusiasts would have penetrated the patriotic skulls of the people associated with the gas industry. The great problem to-day with regard to low-temperature carbonization was the initial erection costs. If they could reduce these, he believed the problem would be entirely solved; and he believed that costs in connection with recent plants had been very much reduced. In conclusion, he emphasized the great influence which the process would have upon abating the smoke nuisance.

THE "COALITE" PROCESS.

Col. W. A. BRISTOW, speaking of the "Coalite" process (with which he is associated), observed that, as a result of the work carried out during the past 22 years, and particularly in the last year or two, during which 160 full-scale retorts had been in continuous operation, he had indisputable evidence that the process had arrived at a stage at which technical difficulties had been removed and commercial success assured. Each week, 1750 tons of coal was being carbonized. The present Parker retort was capable of distilling continuously a wide range of washed coals, coking or non-coking, and could always be discharged without difficulty. The cost of upkeep and renewal had been negligible, and not one single retort out of the 160—most of which had been in operation for over a year—had had to be put out of action. The cost of labour for operating the process was less than 3s. per ton, and at the second works it would be a little over 2s. The solid residue produced, which was sold as "Coalite," was very much appreciated by the public. It could be transported without making smalls; the whole output of the works was delivered as made; and the demand for it was much greater than could be met until more works were in production. The price paid for the fuel—and readily paid—was the same as that paid for best household coal, and was greatly in excess of what the public would pay for any variety of high-temperature coke. The bye-products, coal oil and crude spirit, were produced at the rate of from 30,000 to 35,000 gallons per week, and were of a quality which ensured a ready sale; the price realized enabling the solid residue to be sold profitably at an economic price. Sufficient work had been carried out on the coal oil to prove that by hydrogenative cracking even present prices might be considerably improved upon. The gross profit weekly, as shown by the works balance-sheets, was a larger percentage than that derived from any other branch of the coal or carbonization industry. Therefore, he bid the authors of the papers to take heart, because things were more optimistic than appeared to be thought.

THE ILLINGWORTH SYSTEM.

Mr. ROY ILLINGWORTH said he felt that low-temperature carbonization must stand on its own feet. Often too high claims were made for it, and it would be far better if, instead of advertising particular activities, as scientists they should deal more particularly with the basis of it, and let the plants erected speak for themselves. A low-temperature plant must be very simple in design, of very low maintenance costs, and must be such that those responsible for it could go to bed at night knowing—not merely hoping—that in the morning it would be still at work. Plants must be designed having regard to the chemical nature of the coal. This did not mean that there should be a particular plant for every ton of coal, but that each of the eight or nine typical classes of coal must be treated on its merits. He had experimented in the early stages with a process involving pre-heating of the coal, but costs were high. As the result of developments, however, a simple plant had been evolved, incorporating the whole of their scientific attitude to coal, and in which any type of coal could be carbonized. The retort was really a chamber oven with cast-iron **H**-pieces across it; and these could be readily designed to suit any particular class of coal. It had carbonized coals from Durham, Wales, and Kent—very highly swelling coals—in the fine state, which meant that they were in the best condition for swelling. The plant had been in operation for five years, and it was still working. The maintenance cost had been extremely low, and anyone was at liberty to see it. A plant of this type was being installed in Kent for Messrs. Pearson, Dorman, & Long. The immediate position which low-temperature carbonization could take was in no sense antagonistic to any other industry. Low-temperature plants could enhance the value of small coal and turn out products which the community would assimilate.

VALUE OF LOW-TEMPERATURE PRODUCTS.

Dr. THOLE emphasized the statement in the paper by Dr. Lander and Dr. Sinnatt that, if low-temperature processes were to show a reasonable profit, not only the solid product, but the tar and gas must be utilized to the full—and profitably. There appeared little doubt that the gas was of excellent quality; and provided it could be transported to the point of user—and there the gas companies' organization seemed to be demanded—it should produce a good profit. The value of the solid fuel depended on the raw material. Some grades of solid fuel were practically valueless; others had a very high market value. As to the liquid products, the aqueous portion contained practically no ammonia, and was more a liability than an asset. In regard to the non-aqueous portion, there was a serious need for a new name. Most prospectuses had referred to it as oil, but it was certainly not oil in the ordinarily understood sense of the word. It was referred to nowadays as tar. It was more like tar than oil, but differed in a great many properties, particularly as regards value, from high-temperature coal tar. It contained 25 p.ct. of a pitch which was very definitely inferior in many qualities to the pitch from high-temperature tar. It contained a spirit—and further spirit could be stripped from the gas—which could be looked upon as a definite asset. It was of very good quality, though it needed more refining—and he pointed out that refining losses were greater than in the case of the corresponding spirit obtained from crude petroleum. With regard to the large bulk of products lying between the spirit and the pitch, there was a serious problem; and he urged that the liquid products had by no means the value which was sometimes attributed to them, while the methods of working them up into finished products were so far unknown.

Dr. A. E. DUNSTAN (Anglo-Persian Oil Company) said that low-temperature tar required to have applied to it a technique of its own; it was no use trying to apply the ordinary routine methods of distillation current in the high-temperature tar industry.

Sections T and V: The Training of Fuel Technicians; and Fuel Organizations.

On Wednesday, Oct. 3, Sections T (Training of Fuel Technicians) and V (Organizations Concerned with the Efficient Use of Fuel in Industry) discussed jointly a number of papers on these two subjects. Sir ROBERT HADFIELD, Bart., F.R.S., who presided, suggested that it was most desirable that the various Universities and Applied Science Departments in the different manufacturing centres should be made of real live use to their local industries, and that there should be installed a new department which might well be termed the "Heat Technology Laboratory," working in association with the fuel departments. As to the essential character of the training of a fuel technician, he said it should comprise a sound fundamental grounding in mathematics, physics, and chemistry. Sir Robert emphasized the statement in the paper by Mr. F. Zur Nedden, of Germany, to the effect that the various organizations in that country supported themselves by their own activities, either entirely from industrial funds, partly from grants of industrial associations, partly from membership subscriptions, and/or from payments for expert advice or special work. No financial or other support was now afforded by the State for the promotion of efficiency in the use of fuel and heat in industry.

The Training of Fuel Technologists.

By Prof. J. W. COBB, C.B.E.

Any consideration of the present and particularly the future of the fuel industries must inevitably raise the question as to how far there exists, and will exist, a corps of trained men in those industries, competent to carry through its inevitable developments and to establish them on the lines of sound industrial practice. It has to be borne in mind that these developments will be along scientific lines, and that while the gas industry and the coke oven industry are established, the methods of training for the supply and renewal of their technical staffs have been largely traditional and empiric, and lack the scientific basis so important for development within their own bounds, and even more vitally necessary for such excursions into the unknown as undoubtedly lie in front. I am going to assume that scientific training will be necessary for those who are to take responsible positions in the future in the fuel industries, and discuss rather the nature of the training than the question of its desirability. In doing this it is with no intention of decrying the value of industrial experience, which is essential before a man can claim to have been completely trained, but simply taking it for granted that, if experience is going to raise a sufficiently stable structure, it can best be done by laying, to begin with, a sound foundation of scientific knowledge. What should be put into that foundation, and how it can best be laid, are open to discussion.

Conversations with people of many types have brought it home to me that there is yet no consensus of opinion as to what is the most useful type of training for the fuel technologist. There are various reasons for this. To begin with, in the past, fuel technology as a profession has been, except in the ranks of the gas engineers, practically unknown, and special training for it as a branch of applied science has been given to comparatively few, and only in recent years. From the general public, and from those who are seeking entry to a profession, its opportunities are not, even to-day, receiving anything like adequate appreciation. One consequence is that hardly any fuel technologists of to-day have entered deliberately upon a course of training in fuel in the same sense as a medical man enters upon a course in medicine. There have, instead, been many methods of approach through chemistry, mechanical engineering, and the general training of works experience. The opinions of a fuel technologist of established position are apt to bear a personal bias, more or less strong according to the individual, in favour of the kind of training which he has himself received. A. was trained as a chemist, and is fully alive to the importance of chemistry, particularly the branch of chemistry in which he specializes. His mental twin-brother B. left school, and enters a works. He is fully convinced that the only training leading to a really thorough knowledge of the industry is that obtained by becoming saturated in early years with a knowledge of detailed practice. The mind which can eliminate this bias entirely is rare, and perhaps we can only ask that such bias be restrained.

Another reason why certain methods of training may be considered to be better than others arises from the width of the subject, and the fact that there is room within it for a number of specialists who have necessarily received different trainings. The thorough investigation of a low-temperature tar can only be undertaken satisfactorily by a highly-trained organic chemist. The problem of gas distribution over long distances and wide areas is purely one of engineering. The decision as to the comparative value of two types of carbonization plant is outside the range of either, but each of these specialists has his place in the industry somewhere, which means that the fuel industries will have to continue to draw upon men trained in many ways and many schools. This does not relieve us from the necessity of coming to a decision as to whether it is not possible to provide a training suitable for the majority of entrants into the fuel industries who are prepared at the beginning to make their choice of fuel technology as a profession, and wish to make the best use of their time at the university for the purpose of preparation.

A comparatively easy way of solving that problem (and a number of similar problems in professional education) is to say: Let it be done by taking a degree course of the accepted type—for example, an honours degree in chemistry or engineering—and superpose upon that an additional period of training in the more specialized work of the fuel industries. There is something to be said for this. In a number of cases I have seen it prove quite a success, and in my own department at the University of Leeds there are regulations making it practicable to follow this method. I have not found that it introduces necessarily any fatal one-sidedness. If the first graduate course has been in chemistry in one case and in engineering in another, there will undoubtedly be a difference in mental equipment even at the end of the specialized course; but, as I pointed out, there is room for such differences, and the special equipment of one or the other may be definitely preferred, and, indeed, specified, by an employer recruiting his staff. He may have in mind particularly the following-up of a new process in the laboratory requiring primarily the faculty for laboratory research. He may have more particularly in mind the actual running of an experimental plant on the small works scale, or a careful study of detail in the design or working of plant already established on the full working scale.

There is, however, one difficulty of an essentially practical kind which, to my mind, places this training of a science degree *plus* special training in fuel out of court as a general solution of the problem. This difficulty is that such a training must increase the necessary expenditure both of time and money. It is good for the few, among whom may be some of the best, but is not generally applicable.

It is necessary to bear in mind that complete professional equipment and competence in any case will require some years of works experience. This is particularly the case with men who are not looking forward to a life of research work in the laboratory, but are aiming at executive positions of one kind or another in industry. Such men will form a corps of executive officers who will give practical and commercial effect to all laboratory discoveries. It is good, and, indeed, essential, to provide a corps of research chemists and experimentalists; but if an industry is to be really progressive and efficient, the managers and under-managers and contractors must have a high measure of scientific competence in order to deal sympathetically and effectively with the results of small-scale work, and translate them into practical success on the full working scale. Moreover, it is to be remembered that, for the great bulk of executive officers, it is not advisable to delay too long their entry into the works atmosphere that they intend to breathe for the rest of their lives. Too long a university course may produce an attitude of mind too rigid for works requirements, and may destroy that capacity for making decisions on grounds that are not quite adequate in the scientific sense, which is so valuable a part of the equipment of the best type of manager.

In the University of Leeds we have now had considerable experience with the course of training which aims at preparing a man in three or four years for entry into the fuel industries. In the first year, chemistry, physics, mathematics, and general engineering are studied, with one hour a week on fuel to introduce him to the subject and, more particularly, to his teachers. In the second year, chemistry and engineering are carried further, but about half the time is given to fuel work. The third year is entirely given up to fuel. Of course, it will be understood that fuel as a subject of university study really involves the advanced study of chemistry, physics, and other subjects, in which a selection is made of those portions of the sciences which have found, or seem likely to find, application to fuel problems; illustrations being drawn from these practical appli-

cations. A subject like chemistry is now so wide that, unless a student is to be over-burdened with masses of mere information, some selection has to be made. It is usually made by the teacher of chemistry, to a considerable extent, on his own interests and preferences. In the case of a fuel student the selection is made, as described above, primarily on a professional basis; and the exclusion of less relevant matter makes it possible, we believe, to give far more adequate and educational treatment to the rest. The physics and chemistry of gases, pyrometry, calorimetry, the study of thermal efficiency in its numerous applications, and the study of refractory materials and the principles involved in their use are all obviously useful in this connection. There remains sufficient scope for the individuality of the teacher, which is, indeed, fully exercised in so new a subject of university study.

In the laboratory the same principle of selection is followed, and a technique is learned applicable to fuel work, which for reasons of time, apart from other considerations, it is not possible to acquire in a more general scientific course, though the principles and practice of that technique are fundamentally scientific.

Lecturers from outside, who are in day-to-day contact with the most advanced practice, give short courses of lectures on chosen subjects. The students are so brought into touch with outside lecturers and also with the research staff and their doings. A colloquium is held once a week to give some training to the students in the art of exposition and discussion. The student is required to spend two out of three months in every long vacation on works. He learns something there of works operations and becomes familiar with the works atmosphere. In the first year, it is usually a general engineering works, but afterwards a gas-works, a coke oven plant, or similar establishment. The temporary connection so formed is sometimes renewed in a more permanent form when the student's course is complete, and it is always useful.

The B.Sc. pass degree is taken at the end of the third year, and many students leave at that time, particularly if they are seeking executive rather than research positions. Approved students are admitted to a fourth year, during which they undertake some piece of research work under supervision, submitting a thesis upon it at the end of the year for the honours degree. This fourth year we regard as essential for the man who intends to specialize on the chemical side.

I have given this brief description in order to illustrate the kind of training which appears to me to be suitable for entrance to the fuel industry, making, however, no exclusive claims for it. The results so far obtained have been of an encouraging nature.

I have considered rather fully the training for responsible positions as fuel technologists of men who can take (as I think they ought to take in the present, and will have to take in the near future) a university training before being regarded as thoroughly equipped for entry upon their life's work. There are, however, many men in the industry to whom important work must be committed, for whom such training need not be considered because it is impracticable. It is true, I think, that the management of processes on the large scale will come to lie more and more with men who have received that training, and that it will be found sound commercial policy to secure such process managers by adequate treatment, as regards both status and remuneration; but the place for the foreman and the skilled workman will remain. The training of these grades is to be considered, bearing in mind that for the time being it includes many assistant managers and others. I cannot claim first-hand experience of this branch of education, and therefore prefer to say very little about it.

The Institution of Gas Engineers, along with the Board of Education, have formulated in this country an Education Scheme which is in working order, with Mr. F. W. Goodenough as Chairman. It aims at providing training, mainly through evening classes, at approved technical schools, in the subjects of gas engineering and gas supply; some centres having approved major courses in gas subjects, and others approved minor courses in gas supply practice, and approved courses in gas fitting. The holding of examinations and the issue of certificates forms part of the Scheme. It is claimed that the existence of the Scheme has led to a detailed consideration of the education problem by many who had previously taken only a general interest in the subject, and that by enlisting local effort in the adoption and working of the Scheme in each district, it has stimulated direct and persistent effort. Employers are asked to facilitate the attendance of their employees at such courses.

My own impression—and I would not claim for it any other description—is that much may be done in this direction by sympathetic treatment, which is particularly called for in the case of employees who, while interested in their work, have no aptitude for the formalities of learning, and who can only be expected to see the beauties of science through the immediate practical applications with which they are familiar.

Discussion.

Prof. J. W. Hinchley (Vice-Chairman), after emphasizing the importance of moral character in students if they were to be first-class men, said he felt that a fuel technician was a chemical engineer who had spent a lot of time in a special study of problems connected with fuel. Unless he was a chemical engineer, he was not capable of handling those composite problems which affected equally the chemical side and the engineering side. In this country they were turning out men who had received education on the engineering as well as on the chemical side—and especially on those problems which were not considered in either engineering or chemical courses, but which came within the subject of chemical engineering—and those men were making their mark. Educational institutions could not carry the education of chemical engineers or fuel technicians to the point at which those men could be put into a works and could become useful members of the organization. The works themselves must always do a great deal in the training of the men after they got to the works. In this connection he suggested that the period allowed for the fundamental scientific training of students was too short in those institutions which were specialist training institutions, and he urged that a long period be devoted to fundamental training and a shorter period on the special subjects, where the total period of the course was only three years. Nothing whatever could make up for lack of fundamental knowledge.

Pay Attention to Fundamentals.

Mr. W. H. Patchell (Past President of the Institution of Mechanical Engineers) said there was a great deal to be done in connection with the training of fuel technologists. In support of Prof. Hinchley's plea that more attention should be paid to fundamentals, he said that the Institution of Mechanical Engineers, in connection with its entrance examination, looked for fundamental training. He suggested that the Institute of Fuel should take up the matter of the teaching of fuel technology.

Bureaux of Fuel Publications.

Mr. J. Roberts said that an enormous amount of research work on various aspects of coal treatment was being carried out in the countries that were represented at the Conference, and numbers of original publications followed each other in rapid succession—so much so that it was a matter of difficulty to keep pace with them. In order to keep abreast of the times, one had to subscribe to several journals, and become a member of too many institutions. This involved the accumulation of a mass of journals and transactions containing considerable material to which the individual rarely referred. This Conference had proved the immense value of an exchange of ideas, and it was for this reason that it was proposed to follow this up by continual interchange of reports on researches and developments. The proposal was the establishment of national and international bureaux of fuel publications, the object of which should be the distribution to its members of those publications on the particular aspects of coal treatment in which individuals were interested. In each country there should be established a clearing house, each member of which would notify the committee if and when he intended to publish a report or paper. An advance copy would be submitted to the committee for scrutiny, and, if considered advisable, the secretary would then notify those members who were interested in the particular subject that the paper was being published, giving a short synopsis. Members would not be expected to inform the secretary if they required copies. Arrangements would be made to have sufficient copies reprinted before the type was distributed, and these would be circulated to members of the circle at appropriate rates. The Institute of Fuel or other suitable body in Great Britain could act as a sort of foster-mother of the bureau. The most important activities would be of a national character, but arrangements could be made to extend the scheme to foreign countries, in the case of papers of outstanding interest. The international body would co-ordinate the efforts of the national bodies as far as considered desirable. It was suggested that this scheme was a necessary step in the further co-operation of the various nations, and would help to carry on the good work already begun with such marked success. He therefore proposed that:

> The International Council shall take steps for the formation of an International Bureau for the exchange of original publications on the treatment of fuel, and that the British National Council shall take steps for the formation of a National Bureau for a similar purpose.

The details of the organization of the national circles could be left to a committee, which should be thoroughly representative of the interests concerned.

The resolution was put to the meeting, and carried unanimously.

Evening Technical Studies.

Mr. R. J. Sargant (Messrs. Hadfield's, Ltd.) agreed that chemical studies must come first in the training of the fuel technician, with a specialization in physical chemistry, because there had been no branch of his own work in the iron and steel industry which had not at the bottom of it some reference to physical chemistry. He pointed out that the training of the men who took up industrial work immediately they left school, and could not afford to go to a university, but whose work was nevertheless of a technical character, had to be catered for. At Sheffield this was done by evening classes; and it was the policy of Messrs. Hadfield's to encourage their men, after the completion of the first course in their special subjects, to take up engineering as well. Mr. Sargant urged that in any industrial organization it was essential that there should be at least one member of the staff whose duty it was to control the fuel organization of the works. He also suggested that "refresher" courses for men who had been in industry for some years would be valuable.

Gas Training in Italy.

Prof. C. Padovani (Italy) said that at Bologna a special course for fuel technologists had been instituted, and the Society of Gas Manu-

facturers in Italy had arranged a six months' course for graduated engineers. The matters treated in this latter course comprised gas chemistry, gas engineering, and economy of combustion; and the engineers kept in contact with the faculties. A national association for the control of combustion had been founded, and would deal with all thermal installations and give advice, while it would also be concerned with the training of men.

Dr. F. S. Sinnatt agreed that the early training of the fuel technologist should comprise chemistry first, then physics and mathematics, and then perhaps the humanities. There was little difference between the knowledge required by the chemical engineer and that required by the fuel technologist. Commenting on the inadequacy of training facilities in this country, he said that in contrast with Britain's great capacity for using fuel, there were altogether only four professors and five lecturers on fuel in the educational institutions. He pleaded that there should be more centres for the teaching of fuel technology. He also emphasized the need for students to have the opportunity of studying the problems in the works. He felt that the fuel technologists in the universities failed in their duties in not going out to find the problems in industry, and to solve them.

Mr. F. S. Giller urged that more attention be paid to the training and advancement of the artisans employed to operate boiler plants, ovens, furnaces, and so on, because these men had it in their power to lose more money in the course of a month through ignorance or carelessness than the designers had in their power to gain in a year.

Prof. Loiret (France) also emphasized the value of general knowledge to a technical man, and in this connection quoted Prof. Le Chatelier, who had said that when an engineer started life he should have 90 p.ct. technical knowledge and 10 p.ct. general knowledge, but when he had gained a high position in industry he should have 10 p.ct. technical knowledge and 90 p.ct. general knowledge. He himself had known men who were first-class engineers, but who had not sufficient general knowledge when appointed to directorates.

Fulham Works of the Gas Light and Coke Company.

VISIT BY DELEGATES.

On Tuesday of last week, delegates to the conference were the guests of the Governor, Deputy Governor, and Directors of the Gas Light and Coke Company at luncheon, at the head office in Horseferry Road, when a party of some 260 sat down, under the Chairmanship of Sir David Milne-Watson, LL.D., D.L. After luncheon conveyances were in waiting to take the guests to the Fulham Works of the Company, where they saw much of interest.

Sir David Milne-Watson (after he had proposed "The King" and "The Sovereigns of the Kingdoms and the Presidents of the Republics Represented") remarked that he could not let the opportunity pass without saying on behalf of the Directors of the Company and himself how very pleased they were to welcome so many of them there that day. They felt honoured to see around them such a number of men of distinction from all parts of the world, who had come to this country for the conference; and they hoped that not the least of the pleasant recollections which the visitors would take away with them would be those of the afternoon they had spent with the Gas Light and Coke Company, whose boast it was that theirs was the largest gas undertaking in the world. The Company were endeavouring by every means in their power to keep themselves abreast of the times; and at Fulham many examples of their activities were to be seen. It was a modern works equipped with every labour-saving device and scientific method for making gas as cheaply and efficiently as possible. There was also on the works an excellent research laboratory in which the Company were trying to solve many of the problems which confronted them.

Tenders for a Large Installation of Coke Ovens.

In order to prove to them further that the Company were by no manner of means behind the times, he would mention that they were at the present moment proposing to invite tenders for a very large installation of coke ovens. They had not yet come to any definite decision in the matter; but the Company were wishful to explore this subject for themselves. He hoped he had said enough to convince those present that the Company were doing the best they could to carry on in the light of modern developments.

If this new coke oven plant were put in, it would add another big unit to their carbonizing capacity—probably in the neighbourhood of 1200 tons of coal per day. What he had said would show them that—in a country which was essentially a coal producing country, and where gas was a natural development of that industry—the gas industry was holding its own, and working hard to keep itself abreast of the times.

Internationalization.

Dr. D. B. Rushmore (United States of America), responding to the toast, made gracious acknowledgment of the kindness of the hosts, and referred to what he described as the outstanding feature of to-day—internationalization of the world. Those, he said, who had given any thought to the years following the war had perceived the national boundaries in all directions breaking down, and internationalization of the world taking their place. The Fuel Conference was a remarkable example of this.

Prof. J. Loiret (France) also replied to the toast in felicitous terms.

THE FULHAM WORKS.

The Fulham Works of the Company are probably the oldest gas-works in London, having been originally constructed in 1829. As was recorded in the "Journal" for Aug. 1 last, the steady growth of the Company's research work on the manufacture of gas has necessitated the opening of a new central research laboratory at Fulham, in addition to the existing laboratories at each of the Company's thirteen gas manufacturing stations. Many problems are being investigated at Fulham, among which may be mentioned the thermal decomposition of hydrocarbons, the effect of blending and briquetting or screening coal prior to carbonization, and various problems connected with the manufacture of carburetted water gas and the purification of gas.

The London County Council, as an independent authority, have for many years past tested all gas sold by the Company; and some 8624 official tests are made annually, in addition to continuous records by automatic recorders to ensure that the standard of 500 B.Th.U. is maintained. In actual fact, the deviation from this standard does not exceed one-half per cent. in any quarterly period.

Consumption of Gas.

The Company's research work is not confined to the problems of carbonization and of the manufacture of the bye-products. The increase in the sale of gas, which during the past five years has amounted to over 37,000,000 therms, was almost equal to the increase in the whole of the preceding twenty years, which was less than 39,000,000 therms. This increase has been due not only to the increased number of gas cooking stoves, gas fires, and water heaters, but to the application of gas to new domestic, commercial, and industrial purposes. The Company maintain special laboratories and workshops at Watson House, Nine Elms, where the problems connected with gas consumption are studied. Careful research into the methods of construction, installation, and consumption is carried on, in order that consumers may have at their service the most efficient, economical, and hygienic appliances obtainable. Tests are made and reports obtained on almost every type of apparatus put on to the market, and on many which are only in the experimental stage. The Company's staff have also been responsible for the introduction of an improved design in many types of appliances.

The increasing number of factory and workshop owners who make use of the Company's technical advice, and who are consumers of gas, are provided for by a special staff of expert representatives, who study on the spot the fuel problems of the many trades and industries in London, and whose services are in constant and growing demand; and also by experimental and constructional workshops in the City, where industrial fuel problems are studied and solved under practical working conditions. Special types of appliances, large and small, are also made at these workshops, or adapted to the individual trade process. There is every indication that the expansion of the industrial use of gas in London will be even more rapid in the near future than it has been in the past decade.

Fulham Carbonizing Plant.

The visitors were escorted by Mr. T. Hardie (the Company's Chief Engineer) and members of the engineering staff over the works, which are being extended and developed on a large scale. During the inspection, the delegates were fortunate in seeing alongside the wharf one of the Company's large colliers, having a capacity of 1750 tons, which was being unloaded by two cranes with 5-ton capacity grabs into a reinforced concrete bunker holding 2000 tons. From this bunker coal is transported nearly half a mile across the storage ground to a central crushing station, at the rate of 250 tons per hour, by a system of rubber belt conveyors.

From there the parties proceeded to the plant for the washing and grading of coke after it has been removed from the retort houses by gravity bucket. They then went to the retort houses, two of which contain 400 horizontal Ω-shaped retorts, 23 in. by 16 in. internal dimensions, and 20 or 22 ft. long. Their combined daily capacity is 500 tons of coal, producing 36,000 therms (6,500,000 c.ft.) of 550 B.Th.U. gas. Fiddes-Aldridge stoking machines are used, and in operation expel the hot coke and lay a fresh charge of from 11 to 13 cwt. In the vertical retort house are 128 retorts of the Glover-West type. This plant has a capacity of 420 tons of coal per day, producing 33,000 therms (6,500,000 c.ft.) of 510 B.Th.U. gas. A further installation of vertical retorts in course of construction was inspected. This plant is of the Woodall-Duckham type, and will have a carbonizing capacity of 51,000 therms (10,000,000

c.ft.) also 510 B.Th.U. gas. The carburetted water gas plant was also visited.

Experimental Plant.

A complete experimental plant has now been installed at Fulham to provide facilities for obtaining accurate information on a working scale in regard to the results obtainable from various coals when using different types of carbonizing plant under varying conditions. The plant has been installed in such a position as to be able to make use also of a section of the existing Glover-West and of the new Woodall-Duckham vertical installations. It has its own train of condensing and purifying, &c., plant, together with special sampling meters and other appliances for measuring and testing products. It will be possible with this new plant to carry out far more valuable investigations into such questions as the influence of temperature and pressure and the results of coal blending than can be carried out in the laboratory. In addition to the experimental high-temperature plant, a low-temperature plant has been installed, on which experimental work is being carried out.

After an inspection of the new research laboratories, tea was provided for the guests.

Foreign Delegates Entertain the British Committee.

"The Members of the Foreign Delegations, World Fuel Conference, at present the guests of the British Committee, request the pleasure of Mr. ——'s company at dinner on Tuesday, Oct. 2, at the Hyde Park Hotel." Behind the formal invitation there lies a touch of that genuine friendship which has animated the whole Fuel Conference. Mr. O. C. Merrill, of the American Delegation, who acted as Chairman and Toastmaster, was the prime mover; and every country was represented at the subsequent gathering.

After explaining the *raison d'être* of the dinner, Mr. Merrill called upon Dr. Giordani, of Italy, who spoke of the efforts of the English people to utilize their coal upon new lines, and said that they felt assured that in this new effort the English people would be successful.

Sir Thomas Holland replied on behalf of the British guests.

M. Hentzel, of Denmark, was enthusiastic over the work of the Conference. He stated that the smoothness and efficiency with which all the organizing work had been carried out reflected the highest credit on all concerned.

Dr. E. W. Smith, Joint Secretary of the Conference, made the important suggestion that the question of fuel was so vast that sectional conferences on different aspects would be advisable. The suggestion was received with enthusiasm; and it may be that the World Fuel Conference will in due course become the parent of a number of sectional conferences, each contributing to the international knowledge of fuel subjects.

M. Busila, of Roumania, expressed his appreciation of the opportunity the Conference had afforded him and all the delegates to understand the world-angles of fuel utilization.

Mr. E. C. Evans spoke of the value of the international knowledge of fuel in relation to the iron and steel trades.

Ing. Oskar Taussig (Austria) likened the World Fuel Conference to an orchestra, with the British Committee playing the rôle of conductor. Each member of the "orchestra" played his own part, but everyone was contributing to the "melody" of better utilization of fuel.

Mr. D. N. Dunlop, the Chairman of the British National Committee, pointed out that the establishment of an international organization such as the World Fuel Conference was a valuable contribution to the solution of the problems of mankind. "World peace is merely an abstraction," he said, "until practical men take things in hand. By bringing together at a Conference such as this representatives from so many different nations, it has been possible to approach that ideal of world peace for which all thinking men are working." He paid warm compliments to the work of Dr. E. W. Smith, who has had charge of the technical arrangements of the Conference; and the company signified their appreciation of the work Dr. Smith had carried out.

Mr. W. W. Burt, the enthusiastic and capable Joint General Secretary, to whose work the outstanding success of the Conference is in no small measure due, was thanked by Mr. Dunlop, on behalf of the Conference, for the ability and zeal with which he had carried out his manifold duties. The Foreign Delegates took the opportunity to present a handsome gold pencil to Mr. Burt, as a token of their esteem. Mr. Dunlop was the recipient of a gold-mounted note case—an indication of the warm regard in which he is held.

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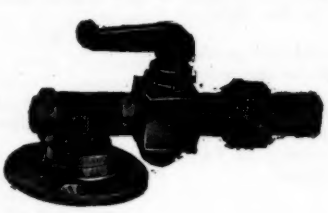

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CORRESPONDENCE.

[We are not responsible for opinions expressed by Correspondents.]

Long-Distance Gas Transmission.

SIR,—I note with some interest that in the recent report of the National Fuel and Power Committee, appointed by the Board of Trade under Lord Melchett and Mr. Frank Hodges after the 1926 coal trouble, with a view to the promotion of new markets for our basic industry, emphasis is laid on the importance of a national system for long-distance gas transmission. I further note that the President of the Board of Trade has authorized the expenditure of a sum of money for a survey under which a more authoritative investigation can take place, as there appear to be a number of problems involved.

In this connection it must be of particular interest to your readers that nearly three years ago—on Feb. 10, 1926—Mr. Harald Nielsen contributed an article to your columns in which he indicated that the problem of long-distance gas transmission was becoming urgent in this country owing to its development on the Continent. It has taken some years for the British Government to come to the same conclusion, but now that the first step has been taken it is to be hoped that the matter will be pressed forward with energy.

It must be clear that the future of this country as an industrial nation depends on cheap manufacturing costs, which in turn are principally dependent on the price of fuel. In its own interests the gas industry should realize that a substantial and early reduction in the price of gas per heating unit is required by British industry. Suppliers of apparatus for handling fuel in other forms are pressing on more efficient methods, and unless the British gas industry is alive to the great opening for industrial gas and the need for a co-ordinated system whereby a larger market brings lower costs, the temptation to British manufacturers in many trades to turn to other means of raising power, heat, and light must seriously affect the industry's position.

The only satisfaction that can be derived from our present position is that through your columns a warning was given some time ago by a gas engineer working with an established British interest.

ROBERT W. S. SETON.

22, Cadogan Gardens, S.W. 3,
Oct. 5, 1928.

REGISTER OF PATENTS.

Distillation of Tar.—No. 273,675.

WESSEL, C., of Essen-Borbeck.

No. 15,252; June 8, 1927. Convention date: June 29, 1926.

The patentee points out that, as contrasted with the known processes, the various constituents of the tar, in accordance with the present invention, are not separated from each other and one after the other at their respective boiling points, but the naphthalene is, as a special fraction, separated by means of steam passed directly into the distilling vessel after the light oil and the water contained in the tar have been removed previously in the same manner. By the use of direct steam, the naphthalene, the boiling point of which is in the neighbourhood of 230° C., and which in the method usually employed hitherto is distilled between 210° and 280° C. in the middle oil and heavy oil fraction, is in an almost pure state distilled off from the tar at a temperature of slightly more than 100° C.

Preferably the tar is heated either before or during the introduction of the steam to a temperature equal to, or higher than, the temperature of the incoming steam, in order to avoid as much as possible any increase of the water contained in the tar. It is immaterial whether or not the water has been previously separated from the tar. By means of suitable dephlegmation the steam containing distillation vapours of the naphthalene can be freed from some admixed vapours of middle oil or heavy oil. The remaining distillate of oil-freed naphthalene *plus* steam is, in the same manner as the former distillate of light oil *plus* steam, separated after being condensed. This separation of the naphthalene from the water, or likewise of the light oil from the same, can be effected, owing to the difference in their specific gravities, easily and clearly in the usual way.

The naphthalene produced is anhydrous after it has been allowed to cool, and contains only traces of oil. For purposes of crystallization the pans required are comparatively small, because the amount of naphthalene constitutes only about one-eighth to one-tenth of the mass of middle and heavy oils containing it in the usual treatment. The use of the centrifugal machine is wholly dispensed with. The middle oil and the heavy oil passing over after the naphthalene fraction are practically free of naphthalene, so that so far as these oils are concerned the cooling process in the crystallization pans, which takes up such a great deal of time and apparatus, becomes superfluous. Hitherto it has only been possible to rid these oils of the naphthalene either by resorting to artificial cooling or by repeating the distillation.

Care should, of course, be taken that the steam is introduced smoothly and that there is an intimate mixture of steam and tar, without the formation of any bubbles or froth; and a suitable form of apparatus is described and illustrated.

Vertical Chamber Ovens.—No. 281,221.

KOPPERS COMPANY, of Pittsburgh (Assignees of J. VAN ACKEREN).

No. 14,325; May 27, 1927. Convention date: Nov. 27, 1926.

This invention relates to vertical retorts, or coking retort ovens of the vertical chamber type, and more particularly to combination vertical chamber ovens embodying heating walls having vertical heating flues therein. The primary object of the invention is to provide a heating system capable of effectively and uniformly heating the elongated coking chambers and which is at the same time capable of close regulation.

The invention consists in providing each heating wall with a plurality of groups of continuous heating flues each consisting of a burner-equipped or flame flue section in series with a section for conveying hot gases; said flue groups being disposed in the heating wall with their burner-sections located in different zones from those of their hot gas flow sections, and with substantially all the area of the heating wall composed of zones containing burner sections of said continuous flues. The avoidance of any appreciable dead zone in the heating wall, and of mingling the primary zone combustion products with fuel gases in the secondary zone, is thereby achieved.

The invention also consists broadly in each combustion zone in a heating wall having its own separate outlet conveying products of combustion from the heating wall; further, in providing a single flow regulating device in the outlet from the secondary combustion zone whereby the relative fuel supply distribution between the zones is very simply and effectively achieved.

A further important feature consists in that, although the products of combustion from the primary combustion zone and the secondary combustion zone are conveyed separately therefrom, they are united in a cross-around flue before being conveyed to an adjacent heating wall for upflow therein and then through the outflow regenerators. This uniting of the products of combustion insures the equalizing of the flow and the temperatures thereof, and that waste gases of uniform flow and temperature are distributed equally through the heating flues and the regenerators of the co-operative associated heating wall. Since the system of connections is symmetrical, the same results are secured upon reversal of the flow. This arrangement insures that substantially equal amounts of waste gases pass through the respective outflow regenerators; and their temperatures are therefore substantially the same.

A battery constructed in accordance with the invention may be provided, also, with means whereby, during the initial heating of the battery, an intermediate portion of a bulkhead or closing wall of the regenerators may be heated to substantially the same temperature as the inner side of the wall, whereby unequal expansion between the intermediate portion and the inner surface is substantially prevented. Liability to fracture of this portion of the wall and the resultant leakages of air are thereby avoided. Outer wall fractures, should they occur, are readily accessible for repair, and are not material if a unitary integral portion separates them from the interior of the battery.

The invention is described in detail and illustrated, and is covered by 13 claims.

Automatic Control of Plant.—No 296,243.

TULLY, SONS, & CO., LTD., and DE REDON, L., all of Newark-on-Trent.

No. 35,356; Dec. 30, 1927.

This invention relates to plant in which various movements are periodically reversed or modified, and more particularly to the control of water gas plant.

Hitherto, say the patentees, the mechanism has been positive in action in one direction only (say, the opening movement of a valve), the reverse movement being obtained by means of counterweights or springs, or by duplication of cams. As a consequence, the working load has either been in excess of that needed for the actual movement of the valve, or part of the mechanism has been unduly complicated; and the present invention has for its object the overcoming of these disadvantages and also the attainment of a more precise control of the various movements.

Broadly, the invention comprises the combination with a shaft and cams thereon—each adapted to displace a member positively in opposite directions through certain minor fractions of its angular movement and to produce no further movement for the remaining and larger fraction of such angular movement—of an oscillating member in continuous operation, provided with a pawl adapted to rotate the shaft in either direction by co-action with a toothed or notched wheel, a mask adapted to be periodically moved to disengage the pawl from such wheel to allow the cam shaft to remain at rest, and a timing wheel for the mask geared to the oscillating member and adapted to permit the pawl to engage its wheel during movement of the oscillating member that carries it, in either direction, thus enabling the cam shaft to be rotated in opposite directions during a cycle of operations. The invention is fully described and illustrated; and it

is also claimed that in a water gas or similar plant, means may be provided whereby, in the event of the air blast failing, the mechanism will act to stop the working of the plant at that part of the cycle where the various valves are in safe positions.

Thermostatic Valves.—No. 296,129.

AIRD, K., and R. & A. MAIN, LTD., both of Grosvenor Gardens, S.W. 1.

No. 14,272; May 27, 1927. (Patent of Addition to No. 268,195, of June 30, 1926.)

This invention relates to modifications of the thermostatically-controlled valve device as claimed in patent No. 268,195 [see "JOURNAL," Vol. 178, p. 243]. Reference is directed to the prior specification for the details of construction.

The modification consists in so forming circular racks on the adjusting member and indicating head that one rack surrounds the other, and the teeth of one enter intertoothed spaces that extend inwardly from the edge or rim of the rack member. Preferably, the rack on the valve-adjusting member is formed by a number of relatively closely-spaced radially-disposed slots in a rim, and the rack on the indicating head comprises a lesser number (*e.g.*, four) of relatively widely-spaced teeth arranged to co-operate with said slots when the indicating head has been assembled. The rack for attachment to the valve-adjusting member may comprise a metal disc having the slots arranged to extend radially inwardly and opening into the rim throughout the thickness thereof. The intertoothed spaces or slots on the one member and the teeth on the other member which are arranged to engage the spaces or slots may be parallel-sided.

Weighting Means for Gasholders.—No. 296,283.

R. & J. DEMPSTER, LTD., KNIGHT, H. S., both of Manchester, and WATERLESS GASHOLDER CO., of Rood Lane, E.C. 3.

No. 11,078; April 14, 1928.

The invention is particularly suitable for waterless holders, in which one method already adopted for weighting has been the placing of a large number of concrete or heavy blocks of material symmetrically about the upper surface of the moving disc or piston.

The object of the invention is to provide for the completed weighting to be attained with the use of a suitably dense substance capable of a viscous or semi-liquid condition with a tendency to harden or set, such as pitch, cement, concrete, or the like having a tendency to flow when in the soft condition, and which may be run in or otherwise supplied where desired, and there allowed to set, thus preventing corrosion of metal parts covered thereby, and covering over cracks.

For this purpose, the upper surface of the disc or piston is provided with compartmental upright walls or plates preferably symmetrically arranged over the area or areas concerned, or preferably so as to divide the total area into a series of receptacles. The shape and number of these compartments may be considerably varied.

APPLICATIONS FOR PATENTS.

[Extracted from the "Official Journal" for Sept. 26.]

Nos. 26,553—27,289.

CHAPMAN, F. W.—"Baffles for geysers." No. 26,589.
FORRESTER, H. J. C.—"Production of water gas." No. 26,913.
HACKFORD, J. E.—"Low-temperature carbonization of fuels." No. 26,857.
HANSEN, C. J.—"Removing ammonia from gases." Nos. 26,706, 26,782, 26,860.
I. G. FARBENINDUSTRIE AKT. GES.—"Production of water gas." No. 26,595.
KROMSCHRODER AKT. GES., G.—"Gas meters." No. 26,755.
MORGAN CONSTRUCTION COMPANY.—"Gas producers." No. 27,033.
MULLER, M.—"Safety devices for gas cookers." No. 26,669.
SULZER FRERES SOC. ANON.—"Installations for dry cooling incandescent coke." No. 26,606.
TEMPLE, H. E.—"Means for carbonizing coal." No. 27,202.
UNION CHIMIQUE BELGE SOC. ANON.—"Process of treating coke oven gases." No. 26,593.
WOLFF, E.—"Doors of horizontal coke ovens." No. 26,898.

[Extracted from the "Official Journal" for Oct. 3.]

Nos. 27,290—28,025.

BENNET, A. J.—"Low-temperature carbonization of powdered fuel." No. 27,727.
CHEMISCH-TECHNISCHE GES.—"Distillation of coal." No. 27,641.
COX, F. J.—"Gas stoves." No. 27,662.
GAS LIGHT AND COKE COMPANY.—"Furnaces for boilers." No. 27,369.
HANSEN, C. J.—"Removing ammonia from gases." No. 27,341.
HUMPHREYS & GLASGOW, LTD.—"Automatic control apparatus." No. 27,735.
HUMPHREYS & GLASGOW, LTD.—"Carbonizing bituminous fuel." No. 27,854.
LEESON, L. H.—See Bennet, A. J. No. 27,727.
METROPOLITAN FUEL COMPANY, LTD.—See COX, F. J. No. 27,662.
STOREY FOUNDRY COMPANY, LTD.—"Gas burners." No. 27,588.
WEST, E.—"Distillation of coal." No. 27,411.
WEST'S GAS IMPROVEMENT COMPANY, LTD.—See West, E. No. 27,411.

MISCELLANEOUS NEWS.

AMALGAMATION OF THE REDHILL AND DORKING COMPANIES.

Board of Trade Inquiry.

At the Offices of the Board of Trade on Friday, Sept. 28, Mr. J. F. RONCA (Director of Gas Administration) held an inquiry into the application by the Redhill Gas Company under the Gas Regulation Act for an Order authorizing the amalgamation of the Redhill and Dorking Gas Companies, to change the name of the Company to the East Surrey Gas Company, and for various other purposes. The Redhill Gas Company were represented by Mr. Jacques Abady, and the opponents—the Reigate Corporation and the Reigate Rural District Council—by Mr. H. Royston Askew.

Mr. ABADY said the manufacturing costs at Dorking were favourable, but the cost of maintaining the works had been considerably higher than the cost of maintaining the works at Redhill. With the amalgamation, it was considered those costs could be reduced, though that process would take a few years. The capital powers of the Redhill Company were £609,720, and the total capital powers of the Dorking Company were £82,363. The Redhill output was 370 million c.ft., and the Dorking output was 80 million c.ft. The form in which the payment was to be made to the shareholders of the Dorking Company involved the alteration of the nominal value of the stock, and it meant a total increase in the capital powers of £23,750. The effect of certain financial adjustments would mean that, instead of the Dorking shareholders being entitled to a total dividend of £3555 per year, they would be entitled to that amount *plus* £355, which amount would be unvariable. The Redhill Company considered that this was a very good bargain. Dealing with the question of the compensation of the Directors, the Secretary, the Auditors, and the workmen, Mr. Abady said that Clause 20 of the Order, sub-section 1, provided that each of the Directors, other than the Managing Director, should get seven times the amount of his remuneration in force; the Secretary would also get seven times the amount of his remuneration; while the auditors would get three times the amount. As regards the workmen, they had the absolute right to continue in the employment of the new Company and to become members of the Company's co-partnership scheme in accordance with the rules for the time being in force. A question had been raised as to the compensation to Mr. J. Urquhart, the Managing Director of the Dorking concern. He was to become a Director of the new Company, and he had undertaken for twelve months not only to manage what would be the Dorking branch of the East Surrey Gas Company, but also to act as a Director and manage the Dorking branch without remuneration for twelve months. An agreement had been come to that he should receive compensation equal to ten times his existing remuneration. They had only just arrived at a decision, and therefore had been unable to notify the Reigate Corporation as to the terms. He wished further to point out that Mr. Urquhart would serve on the Board of the new Company, after the twelve months, at the remuneration he had been receiving prior to the amalgamation. Dealing with the objections raised by the Reigate Corporation, Mr. Abady thought that such objections were based on a misunderstanding as to the terms and conditions.

THE OBJECTIONS.

The first objection was that the proposed terms of purchase of the Dorking Gas Company's undertaking were too generous, and that the result of the proposed arrangement would be that the shareholders of the Dorking Company would receive more in dividend than they did at present, and as a preference dividend, not as an ordinary dividend. Moreover, the dividend would be a preference dividend in a larger and more substantial Company, and therefore a more marketable security. The extra sum of £355 which the Dorking shareholders would obtain, said Mr. Abady, was only equivalent to between 4/100ths and 5/100ths of a penny per therm, and in comparison with the advantages which would accrue to the consumers of the Company generally from the amalgamation of the two Companies, that small increase was negligible. With regard to the objection that the Dorking shareholders were to receive preference dividend in place of their existing ordinary dividend, the consumer would benefit by that, inasmuch as the rate of dividend would not increase as the price of gas was reduced. At the same time, the larger part of the capital of the amalgamated Company would still be ordinary capital subject to a standard dividend, thereby encouraging the Company to keep down the price of gas in order that the ordinary shareholders might benefit in their dividend by the sliding-scale. At the same time, it was incorrect to say that the Dorking

shareholders' existing dividend was dependent upon the profits of each year, because any deficiency was safeguarded by a reserve fund and by their right to carry forward a balance to the credit of the profit and loss. Further, the Dorking Company had at present the right to make up arrears of dividend, which right would cease on the amalgamation with the Company; and the arrears amounted to a considerable sum.

The second point raised was against the proposal to enable the Redhill Company to charge an increased price for gas in the Urban District of Dorking, the Parish of Dorking Rural, and part of the Parish of Mickleham, of 0·8d. per therm, and to consumers within the remaining part of the limits of the Dorking Company an increased price not exceeding 1·4d. per therm. Mr. Abady said that the Company would be prepared to prove to the Board that the proposed differential was fair as between the existing consumers and the consumers in the new area. Careful estimates had been made, and the Company had satisfied themselves that the differential proposed would prevent any unfairness as between the new and the old area.

The next objection was to the establishment of a renewals fund in the ordinary way. This, it was complained, would enable the Redhill Company to appropriate out of revenue an additional sum of £3347 per annum, or 0·4d. per therm. The Redhill Company were, under their existing Acts and Orders, pointed out the Corporation, entitled to form a special purposes fund out of revenue equal to 1 p.ct. per annum of the paid-up capital of the Company; and it was urged by the opposition that the effect of the establishment of a renewals fund in addition would be to increase the paid-up share capital to £71,000, of which £21,000 was nominal increase, or watered capital. In this way, the allocation to the existing special purposes fund by the Redhill Company would be increased by the sum of £710 per annum. The Corporation submitted that in these circumstances, if the Board of Trade should see fit to allow the Redhill Company to form a renewal fund, in addition to their special purposes fund, the annual appropriation should not exceed ½ p.ct. per annum, with a maximum of 5 p.ct. on the paid-up share capital of the Company. Further, in view of the heavy annual charge for compensation to the Directors and officials of the Dorking Company, and the cost of this Order during the next three years, no appropriation from revenue account to the renewals fund should be permitted until the expiration of three years from the commencement of the Order. The Order made no provision for dealing with the existing reserve fund of the Dorking Company, and the Corporation submitted that this fund should be carried to the credit of the proposed renewals fund, and should form the nucleus of that fund.

Mr. Abady, continuing, said that, as the Corporation stated that the proposed renewals fund would enable the Company to appropriate out of revenue an additional sum of £3347 per annum, it would appear that the purpose of a renewals fund had been misunderstood. The clause provided that the fund should be applied from time to time for the purpose of equalizing, as far as might be, the annual charge to revenue in respect of such expenses—*i.e.*, maintenance and renewal—so that in years where heavy renewals accrued the existence of the fund would actually reduce the charge which it would otherwise be necessary to make against revenue in that year. This was a distinct advantage, both to the Company and to its consumers, for it helped to avoid fluctuations in the price of gas. Then again, the Corporation referred to the increase in the paid-up capital of the Company amounting to £71,000, and they said that £21,000 of this was watered capital. That figure was incorrect, as the amount of premiums received had not been taken into account. The Corporation then said that in this way the allocation to the existing special purposes fund by the Company would be increased by the sum of £710 per annum. The suggestion rather was that the £21,000 so-called watered capital was responsible for the increase to the special purposes fund of the whole of the £710 per annum. This, of course, was not so, and the greater part of that addition was in respect of the larger undertaking which would result from the amalgamation of the two Companies. The Company submitted that the policy hitherto pursued as to the accumulation of funds showed that they could be trusted to exercise the powers reasonably; and they submitted that there was no ground for postponing the operations of the renewals fund for three years. With regard to the existing reserve fund of the Dorking Company, this would continue as a reserve fund in the amalgamated Company. A nucleus for the proposed renewals fund already existed in the "Repairs and Retort Renewals Suspense Account" of the Dorking Company.

The Corporation next objected to the proposal to pay compensation to the Directors and Managing Director of the Dorking Company. In regard to this, continued Counsel, he thought he would satisfy the Board of Trade that it was only fair that the Managing Director of the Dorking Company should be compensated for loss of office.

Finally, the Reigate Corporation raised objection to the new capital powers. All he could say in regard to this, said Mr. Abady, was that it was only proposed in the Order to transfer the existing unexercised powers of the Dorking Company to the amalgamated Company, and at the same time to take power to borrow the usual proportion of one-third of the amount of the ordinary capital. The Company were prepared to satisfy the Board of Trade that the unexercised capital powers would not be more than was reasonable to meet the probable requirements during the next twelve years. Mr. Abady pointed out that the amalgamation had been approved by the Directors and shareholders of the undertakings.

The consumption of gas in the Borough of Reigate, Mr. Abady said, had increased from 206 million c.ft. in 1923 to 369 million c.ft. in 1927, which was a 19 p.ct. increase in four years, whereas in the Reigate Rural District it had increased over the same period from 66 million c.ft. to 88 million c.ft., or 33 p.ct. in four years.

Evidence in Support of the Application.

Mr. *White*, a Chartered Accountant, said that his view was that the Redhill Company had made a distinctly good bargain in getting the Dorking Company to accept stock which only gave £355 per annum, instead of big dividends. It was very clear that the time was close at hand when the Dorking Company could pay back dividends; and if those back dividends were spread over a long period, they would be worth many thousands of pounds.

Mr. *W. A. Valon*, Consulting Engineer to the Redhill Gas Company, said that the gas sold by the Redhill Company last year was 309,959,800 c.ft., and there were 10,455 consumers, while the length of mains approximated 150 miles. The price of gas per therm was 12·8d. within the Borough of Reigate and 13·6d. outside in the rural and urban areas, while notice had been given to reduce that price as from Oct. 1. The Dorking Works were situated close to the town station, where there was room for further extension. The price charged for gas at Dorking was 15d. per therm, and he thought the terms of the amalgamation were very fair to Dorking. There had been an expansion of consumption in Dorking, where in 1922 it was 53,673,000 c.ft. and in 1927 80,072,000 c.ft. In Redhill the consumption in 1922 was 270,612,000 c.ft. and in 1927 369,960,000 c.ft. There was not much scope for extension in the Borough of Reigate, which was well built upon, whereas in Dorking the extension of the building operations was phenomenal. Everywhere estates were being broken up and developed for building purposes. They had a high-pressure main which would easily connect the areas covered by the two undertakings, as a result of which the Redhill Company could more easily supply the Rural District than could the Dorking Company. The amalgamation would naturally mean a considerable saving in the administration.

Witness, in answer to Mr. Askew (for the opposition), said that some of the plant at Dorking was thirty years old. The retort house was erected two years ago and was a well-built, solid structure—one of the best he had seen. It was only natural that if they remodelled the plant they would be putting in up-to-date equipment which would mean a great saving in the cost of manufacture. He understood that they would retain the existing retort plant at the Dorking Works for a time. Later it would be remodelled, but that would not be a heavy charge. Roughly, at the present moment the charge was 2d. more per therm at Dorking than it was at Redhill; but he saw no reason why that extra 2d. should exist after a few years, because it must be borne in mind that it would take a year or two before they could level up the costs all round.

Mr. *W. H. Bennett*, the Managing Director of the Redhill Gas Company, said that they would not dismiss any of their employees as a result of the amalgamation, but there would be a natural decrease of the staff owing to the fact that they had joined a larger Company, and the prospects for promotion were not so great. There was no doubt that as far as the Dorking Works were concerned, if they remained a separate entity they would have to be remodelled; but he did not think that would be necessary as the result of the amalgamation.

The Case for the Opposition.

Mr. Askew, in the course of his address, pointed out that the two authorities between them represented practically the whole of the existing consumers in the Redhill Company's area; and they felt it was their duty to examine the Order very carefully. They found that the Order as it was drawn up was very prejudicial to the interests of the consumers and of the ratepayers within the Corporation's area and the Rural District. If the present Order were passed in the form in which it had been put forward, it would be unfair, and would create an injustice from the point of view of the Reigate consumers. He thought the Redhill Company had agreed to demands from the Dorking Company which would definitely put a burden on the Reigate consumers. There were various points in the Order to which they took objection; and each of these points had a financial bearing on the differential price. Their points of objection were several. As regards the reserve fund, he asked that the Dorking reserve fund should be put in part to the special purposes fund, and should not be part of the renewals fund. With regard to the renewals fund, they claimed that there should be no allocation from revenue for three years from the date of the Order, and that the amount should be reduced to ½ p.ct. per annum with a maximum of 1 p.ct. As regards the differential price, the Corporation considered it should be compulsory for a longer period of years; and he was instructed to ask that it should be for a term of fifteen years. As to Directors' compensation, he contended that the full amount to be paid to the Managing Director of the Dorking Company should be submitted to, and approved by, the Board of Trade. The Corporation were willing to leave to the Board of Trade the question of capital powers so that there should not be more than would suffice for twelve years. These he submitted were the minimum alterations in the terms of the Order, and would provide a safeguard for the consumers in the existing area of supply of the Redhill Company.

Mr. Abady's Reply.

Mr. Abady, in replying to the opposition's case, submitted that very rarely had he listened to a more loosely constructed but vehement attack on the principles of amalgamation and the discretionary power of a responsible Board of Directors in carrying on their undertaking within the liberty allowed them by Parliament. It was a little startling for the opposition to make an attack on the condition of the works, which were open for inspection by their Engineer, who had never even taken the trouble to view them, and therefore did not know their condition. He submitted that his clients came before the Director with a well-thought-out scheme. It was agreed that the manufacture would continue at both works, and the high-pressure main running through Dorking would have the effect of giving an economical supply to the districts of the Dorking area where no supply at present was possible. Under the scheme the cost of manufacture would be less all round, and they had come to the conclusion that 0·8d. as the differential was the most they were justified in asking the Board of Trade to allow. The promoters were sure that the construction placed on the various points by the Reigate Corporation and the Reigate Urban District as to the effect on the consumers was entirely misconstrued.

GAS REGULATION ACT APPLICATIONS.

SPECIAL ORDERS.

Burnley Corporation.

To empower the Corporation to contract with any local authority, company, or persons for the supply by the Corporation to them, or for the supply to the Corporation by them, of gas in bulk, and to borrow the sum of £60,000 for the purpose of purchasing, erecting, and laying the plant and mains required in connection with the supply of coke oven gas from Altham to the Corporation's Oswald Street Gas-Works.

Cirencester Gas Company, Ltd.

To extend the Company's limits of supply so as to include the parishes of Siddington and South Cerney.

Ipswich Gas Light Company.

To confirm the purchase by agreement by the Company of the shares of the Woodbridge Gas Light and Coke Company, Ltd.

DECLARATION OF CALORIFIC VALUE.

Cockermouth Urban District Council.—450 B.Th.U. (Jan. 1, 1929.)

Yorktown (Camberley) and District Gas and Electricity Company.—In parishes named, 450 B.Th.U., in substitution for 475 B.Th.U. (Jan. 1, 1929.)

STOCKPORT GAS DEPARTMENT.

The Engineer and Manager of the Stockport Gas Department (Mr. S. Meunier), in his report for the year ended March 31, stated that the activities of the Department had been confined chiefly to consolidating the position created by the abnormal conditions of 1926-27. The cost of manufacture of coal gas had dropped from £105,786 to £79,045, and of water gas from £9888 to £2406. Notwithstanding an increase of over 8 million c.ft. in gas sold, the revenue from gas was less by £10,997, due to the reduction in price as from April 1, 1927.

In spite of the abnormal increase under the heading "Stoves and Services" in 1926-27, there had been a further increase of £220, which was a safe guarantee for the future of the Department. There was also a satisfactory increase in the number of consumers—namely, 1122, included in which total were 570 houses which had returned to the use of gas after having given it up. The gas unaccounted-for had improved from 6·64 p.ct. to 5·38 p.ct., due largely to constant watchfulness and prompt attention to fractured mains. The majority of cases were caused by the heavy modern traffic on the roads, which placed a heavy expenditure on the Department; and the Engineer considered this should be a charge against the Road Fund. Extensions to washing plant had been completed, two new station meters had been installed, and good progress was being made with an extension of the purifying plant. A new high-pressure main to Bramhall, referred to in his previous report, was also nearing completion. The total quantity of gas made was 1160 million c.ft., of which 1032 million c.ft. was sold.

COAL TRADE REPORTS.

From Our Own Correspondents.

NORTH-EAST COAST.

The feature of the market is the steady improvement which has been showing in Northumberland coals. For many months the position in the county, which is almost entirely an exporting district, has been one of unrelieved gloom. The collieries, however, classified their coals and arranged a minimum price agreement, below which they would not sell. The arrangement has been loyally adhered to, and it appears at length to be taking effect. The collieries are much better sold for the next few weeks, and some of them are even able to indicate prices above the minimum.

Durham, on the other hand, where selling schemes have gone little beyond the discussion stage, is in worse plight now than it has been for a long time. Prices have weakened steadily in the last two months, and, in spite of this, idle time has increased. The shortage of shipping has affected the position to a considerable extent; but the demand for gas and coking coals has also been very disappointing.

In the past week, there was some slight improvement towards the end in better class gas coals. Wear Specials were quoting up to 15s. 6d. f.o.b., against a previous maximum of 15s. 3d., and best qualities were firmer at 14s. 9d. Seconds and others are still easy at 13s. to 13s. 3d., with several brands obtainable for prompt down to 12s. 9d. Best coking unscreened makes are no better than 13s. 3d., while quite good ordinaries are offering at 12s. 9d. Durham bunker coals are still weak; best sorts at 13s. 6d. to 13s. 9d. f.o.b., and others 13s. to 13s. 3d. Gas coke is improving with more tonnage offering, and 19s. 6d. to 20s. f.o.b. is asked for shipment.

YORKSHIRE AND LANCASHIRE.

Gas coals are moving against contract, with indications of prices somewhat appreciated. Industrial fuels generally are rather easy. Export figures are normal. House coal has moved slowly during the past week, and prices have remained normal.

The following are the Humber bunker and export prices, f.o.b. usual shipping ports:

South Yorkshire—Hards, Association, bunkers 20s., export 15s. 6d. to 16s.; screened gas coal, export 15s. 6d. to 16s.; washed trebles, 15s. 6d. to 16s.; washed doubles, 14s. 6d. to 15s.; washed singles, 13s. 6d. to 14s.; washed smalls, bunkers 14s. 6d. to 14s. 9d., export 10s. 6d. to 11s.; smithy peas, 16s. 6d. to 17s. 6d. per ton.

West Yorkshire—Hartley's (f.o.b. Goole), bunkers 17s. 6d., export 14s. to 15s.; screened gas coal, export 14s. to 15s.; washed trebles, 15s. to 15s. 6d.; washed doubles, 13s. 6d. to 14s.; washed singles, 12s. 9d. to 13s. 3d.; washed smalls, bunkers 14s. 6d. to 15s., export 11s.; unwashed trebles, export 14s. 6d.; unwashed doubles, 11s. to 11s. 6d.; rough slack, 8s. 9d. to 9s. 3d.; coking smalls, 8s. 6d. to 9s. 6d. per ton.

Derbyshire and Nottinghamshire—Top hards, bunkers 19s. 9d. to 20s., export 15s. to 16s.; cobbles, 15s. to 16s.; washed trebles, 15s. 6d. to 16s.; washed doubles, 14s.; washed singles, 12s. 9d. to 13s. 3d.; washed smalls, bunkers 14s. 3d. to 14s. 6d., export 10s. 6d.; unwashed doubles 11s. to 11s. 6d.; rough slack, bunkers 12s. 9d. to 13s. 3d., export 9s. to 10s. per ton.

Yorkshire, Derbyshire, and Nottinghamshire—Screened steam coal, bunkers 17s. 6d. to 18s. 6d., export 12s. to 13s. 3d.; gas coke, export, 21s. to 23s.; furnace coke, 19s. to 19s. 6d.; washed steam, Goole, bunkers 16s. to 16s. 6d., Hull (West Yorks.), bunkers 17s. 9d., (South Yorks.) bunkers 18s. to 18s. 6d., export 14s. 9d. to 15s. per ton.

MIDLANDS.

Pits are making a larger output in their endeavours to catch up with the seasonal burst of trade in household coal. There has been another revision of prices, and future developments will depend upon the strength of demand. In a few instances industrial consumers are taking rather larger tonnages. Increased quantities of slack are going into consumption. The reversion to solar time involves bigger requirements for electric lighting as well as for gas lighting, and more coal is needed for the heating of dwelling houses, hotels and clubs, factories, and other industrial and business places.

The difficulty is to equate the various branches of supply. There is not sufficient industrial demand to absorb the increased output of those classes of coal which are not suitable for domestic consumption. Spot lots of "D.S." nuts and beans have reappeared. Notwithstanding the stimulus which the trade in slacks has received, market conditions remain very easy. The gas-works are so well stocked that it will be some little time before deliveries will need to be amplified to cope with the lighting load.

In the circumstances, industrial fuel has been very little affected by the appreciation of household coals. Rather higher prices are being asked for furnace cokes; some smelters say they had to pay 6d. a ton more. There is no very decisive change, however. Blast-furnace coke can still be bought round 12s. 6d. at ovens.

Advances on household coal vary according to the pressure. At collieries where summer prices continued up to October 1s. 8d. to 2s. has been added. Those which put 1s. on at the beginning of September have advanced a further 1s. In special cases the increase has been greater.

CURRENT SALES OF GAS PRODUCTS.

The London Market for Tar, Tar Products, and Sulphate.

London, *Oct.* 8.

There is not much business reported in pitch; but the price is still called 45s. per ton f.o.b. makers' works.

Creosote is about 7d. per gallon.

Pure benzole is about 1s. 8d. per gallon.

Solvent naphtha, 95/160, 1s. 5d. to 1s. 6d. per gallon.

Pure toluole is about 2s. per gallon.

Pyridine is about 5s. per gallon.

Tar Products in the Provinces.

Oct. 8.

The average prices of gas-works products during the week were: Gas-works tar, 31s. 6d. to 36s. 6d. Pitch—East Coast, 42s. 6d. to 45s. f.o.b. West Coast—Manchester, 37s. 6d. to 38s. 6d.; Liverpool, 39s. 6d. to 40s. 6d.; Clyde, 39s. 6d. to 40s. 6d. Toluole, naked, North, 1s. 5d. to 1s. 6d. nominal. Coal-tar crude naphtha, in bulk, North, 9d. to 10d. Solvent naphtha, naked, North, 1s. 1½d. to 1s. 2d. Heavy naphtha, North, 1s. to 1s. 0½d. Creosote, in bulk, North, liquid, 5¾d. to 6d.; salty, 5¾d. to 5¾d.; Scotland, 5¾d. to 5¾d. Heavy oils, in bulk, North, 8¼d. to 8¼d. Carbolic acid, 60 p.ct. 1s. 11d. to 2s. prompt. Naphthalene, £13 to £15; salts, £5 to £5 10s., bags included. Anthracené, "A" quality, 2½d. per minimum 40 p.ct., purely nominal; "B" quality, unsaleable.

Benzole Prices.

The following are considered to be the market prices to-day:

	s. d.	s. d.	
Crude benzole	0 10½	to 0 11	per gallon at works
Motor "	1 4½	" 1 5	" " "
90 p.ct. "	1 7	" 1 8	" " "
Pure "	1 10	" 1 11	" " "

While the Trades Exhibition was being held at the Dewsbury Town Hall from Sept. 29 to Oct. 6, promoted by the Dewsbury and Heavy Woollen District Chamber of Trade, the Dewsbury and Batley Corporation Gas Departments, respectively, made special displays of domestic gas appliances at their showrooms at Nelson Street, Dewsbury, and at the fine new showrooms at Batley. At Dewsbury the display was of a general character, including cookers, washing equipment, fires, lighting fittings, and refrigerators; while at Batley a speciality was made of lighting, arranged in conjunction with the Welsbach Light Company, Ltd., and was a striking illustration of what gas lighting can achieve. Dewsbury gas charges were reduced on Sept 30.

TRADE NOTES.

Six-Wheeled Steam Wagons.

Messrs. Richard Garrett & Sons, Ltd., of Aldwych House, W.C. 2, have just published a very interesting catalogue of their latest designs of steam wagon, showing the advantages of the rigid six-wheeled type. A quarter of a century of progressive steam wagon manufacture has enabled the makers to bring these models as near perfection as is possible with any heavy haulage vehicles. The Company will be pleased to send copies of the booklet to any of our readers who are interested.

Manufacture of Concrete Blocks.

Modern Building Construction, Series No. 1, "Standard Practice for the Manufacture of Concrete Blocks," is a most useful text book dealing with this subject. The particulars given are based entirely on positive technical and practical experience, and its twelve pages are well worth the study of those interested in building projects. The book is presented for the purpose of promoting the manufacture of concrete blocks of the very highest quality. The notes are a compilation of the processes and methods followed in various block factories, briefly described, so that if desirable they may be adapted to the needs of any block making plant. "Standard Practice for the Manufacture of Concrete Blocks" may be obtained free of charge on application to the Portland Cement Selling and Distributing Company, Ltd., 20, Buckingham Gate, S.W. 1.

CONTRACTS OPEN.

Coal.

The Gas Committee of the Darwen Corporation invite tenders for the supply of gas slack and nuts. [See advert. on p. 147.]

Stoking Machine.

The Dumfries Gas Department invite tenders for the supply of a combined stoking machine. [See advert. on p. 147.]

Wagons, &c.

The Plymouth Corporation Gas Department invite tenders for the supply of side-tipping coal wagons, rails, &c. [See advert. on p. 147.]

Carburetted Water Gas Plant.

The Gas Department of the County Borough of Rotherham invite tenders for two sets of carburetted water gas plant. [See advert. on p. 147.]

"The Romance of Artificial Lighting."—This will be the subject of a lecture by Captain W. J. Liberty on Oct. 22, before the Argyle Guild, at Bath, when Mr. J. Wesley Whimster, the Engineer and Manager of the Bath Gas Light and Coke Company, will take the chair.

Gas at Sheffield Housekeeping Exhibition.—At the "Sheffield Telegraph" Housekeeping Exhibition, which was opened by the Lord Mayor (Alderman M. Humberstone) at the Edmund Road Drill Hall on Oct. 2, the Sheffield Gas Company played a considerable part. The outdoor lighting of the hall was placed entirely in their hands, and powerful units of 6000 c.p. were fitted up. The Company's stand occupied a prominent position, and was one of the most attractive in the exhibition. A wide range of gas cookers of pleasing appearance, gas fires which would meet the requirements of any furnishing scheme, hot water appliances showing the capabilities of water heating by gas, and neat lighting fittings were to be seen in great variety, while information concerning their working was supplied.

A Triumph for Mechanism.—In a report to the Belfast City Council, the Gas Manager, Mr. J. D. Smith, M.Inst.C.E., states that the system of machine accounting introduced on April 1 over the entire work of the Gas Department has come up to the highest expectations; that the staff have become familiar with the use of the machines; and that the problem presented by the congestion of the office due to crowds of gas consumers waiting to pay their accounts has now been solved, for the staff are able to deal with the public rapidly and efficiently under the new system. The Committee expressed satisfaction with the result of the mechanical equipment, and authorized the purchase of two new machines on the terms indicated by the Manager.

Reduction in Barrow Gas Prices.—At their October meeting, the Barrow Town Council agreed to the recommendation of the Gas Committee that the price of gas be reduced by a further 2d. per 1000 c.ft., making a total reduction of 6d. per 1000 c.ft., and that it take effect from the readings of the meters for the September quarter. There was some discussion; Alderman Whinnerah raising the question as to whether the reduction should not be 7d. or 8d. per 1000 c.ft. The profit on the gas undertaking for the past three months, he said, had been £2102, and, assuming that there was a similar profit for the current quarter he wanted to know what the income-tax payment would be on profit for six months amounting to £4200 or £4300. Alderman Thompson pointed out that they were a trading committee, and it was not possible to say exactly what their position would be at the end of the financial year. In view of the condition of their Hindpool Road Works, they might have to meet the cost of special repairs, &c., and they had to keep on the safe side with their finances. Alderman Whinnerah said he agreed that the Committee were wise in playing for safety. He then made a long statement to the effect that the prepayment meter users had been for a long time paying more than the minutes of the Council justified. He moved that all prepayment meters be stamped, so that consumers might know exactly the kind of meter in use, and that all receipts should state how much gas had been consumed and the price paid. Alderman Thompson said the matter might usefully go to the Gas Committee for discussion, and the Council agreed.

South Suburban Gas Company's Capital Issue.

In our advertisement pages to-day, the South Suburban Gas Company are offering for tender £300,000 of 5 p.ct. ordinary stock at a minimum price of £106 10s., and £100,000 of 5 p.ct. perpetual debenture stock, at a minimum price of £99. Tenders must be received by the Company by noon on Tuesday, Oct. 16. The rapidly developing area supplied by the Company comprises 166 square miles, and includes parts of the Metropolitan Boroughs of Lewisham, Camberwell, and Lambeth, and the County Borough of Croydon, and the whole of Beckenham, Penge, Bromley, Orpington, Chislehurst, The Crays, Sidcup, Bexley, &c., and the important industrial districts of Crayford, Dartford, and Erith. The progress of the Company's business is indicated by the fact that during the past five years the sales of gas show an increase of 34½ p.ct., while nearly 20,000 additional consumers have been secured. The annual sales of gas approximate 19,000,000 therms, and the consumers number about 109,000. The Company now ranks fourth among the Metropolitan and Suburban gas undertakings. It is anticipated that the rate of dividend—namely, 6¼ p.ct. per annum—which has been paid upon the 5 p.ct. ordinary stock during the past five years will be fully maintained.

"The New Coal Age."—This is the title of a new publication dealing with low-temperature carbonization and the scientific treatment of coal. It will be published monthly at 6d., and will be illustrated. The September number contains an open letter to the Prime Minister—a plea for a national coal carbonizing scheme—and an open letter to British industry on the advantages of adopting coal carbonization. The Editor of the new monthly is Mr. R. W. Johnson.

Gas Cooking Competition in New Zealand.—At the Auckland Winter Exhibition last July, an interesting competition was held for the Auckland Gas Company's Show Cake Prize. The winning cake was cooked in a gas cooker made by Messrs. John Wright & Co., of Birmingham, whose representative presented the prize on behalf of the Gas Company. The cooker was fitted with the "Regulo" oven control, by which the cooking is done without the necessity of any attention; and that the result clearly demonstrates the remarkable efficiency and convenience of the modern gas cooker with this system of control is shown by the fact that the winning competitor in the previous year used a "Regulo" controlled oven.

The Use of Gas in Industry.—In a publication bearing the title "The Biscuit," which was printed at the Reading Industries Exhibition for issue last Thursday, there was a highly interesting article by Mr. Douglas H. Helps, the Engineer and Manager of the Reading Gas Company, on "The Use of Gas in Industry." He referred to the increasing application of gas in the textile trades, in hat making, in boot manufacture, in the motor car industry, and for all manner of metallurgical operations. In Reading gas is largely used for industrial purposes. One firm alone consumes 55 million c.ft. per annum, and eight other firms consume from 3 million to 21 million c.ft. a year. The output of gas in Reading doubles every eighteen years.

Gas-Works Centralization at Barrow.—At their meeting on Oct. 1, the Barrow Town Council agreed that the Chairman of the Gas and Water Committee should take back for further consideration a proposed scheme for centralization of the gas-works. The minutes of the Gas Committee stated that the Sub-Committee dealing with the matter had considered the question of the engagement of an expert, but had come to the conclusion that it was not necessary to engage one. They also resolved that the Manager prepare and submit complete schemes providing for horizontal retorts, and estimates of the cost of centralizing the gas-works at Hindpool Road and Salthouse respectively, and that the Borough Treasurer submit a report on the financial aspect of both schemes. The Manager submitted a copy of the "GAS JOURNAL" containing an article on horizontal retorts; and it was resolved that he forward a copy thereof to each member of the Gas and Water Committee. Alderman Whinnerah, a former member of the Gas Committee, in the discussion which resulted in Alderman Thompson, the present Chairman of the Committee, agreeing to the reconsideration, said he did not like the decision not to have an expert's report; and he urged that in many towns they were scrapping horizontal retorts for vertical retorts.

Cost Accountants' Part in Industrial Prosperity.—Cost accountants and their part in the future industrial prosperity of Great Britain formed the subject of discussion at the National Conference of the Institute of Cost and Works Accountants at Birmingham on Friday, Sept. 28. Mr. Alexander Ramsay, Chairman of the Engineering and Allied Employers' Association (Birmingham and Wolverhampton District), opening the conference, said that cost and works accountants were putting industrial process under the microscope, and making them actuarially sound. Mr. J. A. Lacey, of Birmingham, remarked that one was at a serious loss to reconcile reduction in costs of production and a continuity of national expenditure at the rate of £850,000,000 per annum. It showed that the task of reducing costs was not merely the responsibility of one element of the community, but a service required of all sections identified in national life. The time was approaching when cost of distribution would yield to the searching inquiry of the expert cost accountant. Prof. J. F. Rees (Faculty of Commerce, Birmingham University) observed that one of the difficulties of the professional economist was to obtain reliable production and distribution costs upon which to base sound conclusions. In the preparation of such figures the cost accountant was beginning to do work vital to the community. Lord Askwith, who was chief guest at the evening banquet, said that waste was still rife in the land, and every little piece of waste got rid of would enable more and more British production to compete in the world. Cost accountants could also give their attention to the undue locking up of capital which existed to an enormous extent in Great Britain.

Cheaper Gas at Bridport.—The Directors of the Bridport Gas Company have announced that, after the meter inspection on Sept. 30, the price of gas for all purposes will be reduced by 3d. per 1000 c.ft.

Cheaper Gas at Stockton.—At the monthly meeting of the Stockton Town Council on Oct. 2, a reduction of 2d. per 1000 c.ft. in the price of gas was agreed upon; the price per 1000 c.ft. being fixed at 3s. 4d. for ordinary consumers. In the Yarm area the price per 1000 c.ft. has been lowered by 3d., to 4s. 10d. There will be a proportionate reduction for gas consumed through prepayment meters. The Chairman of the Gas Committee (Councillor **T. Wilkinson**) observed that this was the second reduction made this year, and involved a total saving to gas consumers of about £10,000.

Health Week.—Excellent work is being done by the Health Week Committee appointed by the Royal Sanitary Institute; and as a result of their efforts the public are beginning to realize that they will only enjoy good health if they exert themselves to remove obstacles to its attainment. One of those obstacles is smoke—an evil which can be greatly lessened by the use of gas and coke. Health Week commenced last Sunday; and gas undertakings will doubtless be arranging their showroom windows on "health" lines. About 2900 local celebrations of Health Week, in connection with about a hundred local health authorities, take place every year in the shape of lectures, exhibits, and so on.

Extensions of the Cockermouth Gas-Works.—A Ministry of Health inquiry was held at Cockermouth on Oct. 5 in connection with an application for a loan of £10,000 for extensions of the Urban Council's gas-works. The extensions have been completed, and paid for by an overdraft on the district rate and a mortgage to the bank on the rate and gas revenues. The Inspector said he had never heard such confused statements in regard to finance for a long time. The application to the Ministry did not state that the works had been carried out, and it seemed that the loan was for work to be done in the immediate future. The Inspector drew attention to the Act requiring the Council to advertise for tenders. The Clerk to the Council and the Manager of the gas-works confessed ignorance of this obligation.

New Vertical Retorts at Halifax.—An additional setting of 32 vertical retorts at the Halifax Corporation Gas-Works was set in operation on Oct. 4 by Sir Enoch Hill, of that town. After the ceremony, Alderman J. H. Waddington (Chairman of the Gas Committee) said that the 48 vertical retorts erected in 1921, at a cost of £65,000, by Messrs. Drakes, Ltd., of Halifax, were so satisfactory—having exceeded the guaranteed output—that, eighteen months ago, 32 more were ordered from the same firm at a cost of £40,000. Sir Enoch Hill commented on the fact that gas had been made at the Halifax Works since 1822, though the concern was then owned by a private company. In 1855 the undertaking was purchased by the Corporation. At that time the cost of a million cubic feet of gas was £878; now it was £400. Twenty years ago they were carbonizing 75,000 tons of coal a year, but to-day, with a vastly bigger output of gas they used only 50,000 tons. With regard to economy of production, Halifax was invariably in the forefront. Alderman Waddington referred to the Halifax scale of charges, drawn up by Mr. W. B. McLusky, their Engineer and Manager.

Stand-by Plant for Rotherham.—When the Rotherham Borough Council reassembled on Oct. 3, the Gas-Works Committee recommended an expenditure of £10,500 for a stand-by gas-making plant. They considered this provision necessary to ensure the continuity of the supply of gas to meet the Council's statutory obligations in case of strikes or lock-outs at the local collieries, or other causes whereby the supply of gas might be cut off by the coke oven gas suppliers. Councillor Clark, the Vice-Chairman of the Committee, pointed out the inadequacy of the present works plant for dealing with an emergency. Some disappointment was expressed that a reduction in the price of gas was not proposed at the meeting. Also, there was doubt as to the expediency of spending further money on the present site. It was a good distance from the railway, and the land—so it was stated—was far too valuable to be occupied with works of that kind. In respect of the supply of coke oven gas an interesting fact was that, though the Canklow Colliery was stopped, Messrs. John Brown & Co. were continuing to build coke ovens there. It was, therefore, possible that in twelve months' time the Corporation would be able to obtain a supply of gas from that source. Councillor Bardsley pointed to the possibilities of a coke oven gas supply from Parkgate, where a large quantity of the surplus was being burnt in the air.

Buxton Gas Engineer's Annual Report.—The annual report of the Borough Gas Engineer, Mr. F. G. Shaw, on the working of the gas undertaking for the year ended March 31 last is very encouraging. Mr. Shaw states that the year showed a remarkable recovery from the difficulties of the coal stoppage of the previous year; and the net profit of £5448 during a period when considerable extra expenditure on mains and services had to be incurred would, he believed, be considered most satisfactory. The make of gas for the year, 185,638,000 c.ft., showed a decrease of 3,329,000 c.ft. The service department had continued to be fully employed, and the maintenance scheme had given great satisfaction to the gas consumers. The use of gas for heating continued to increase. The work done in extending and renewing mains and services had been unusually heavy during the year. The number of ordinary consumers at March 31 was 2207, and the prepayment meter consumers numbered 2025—an increase of 160. There were 1983 cookers on hire. The net revenue from the sales of gas for the year was £27,427—or 3s. 1·5d. per 1000 c.ft. sold—as compared with £30,336 and 3s. 4·7d. per 1000 c.ft. sold for the previous year. This reduction was due to the decrease in the price of gas following the coal strike. The further reduction in the price of gas of 2d. per 1000 c.ft. from the March readings will result in an estimated reduction in gas profits of £1700 during the current year. Mr. Shaw makes appreciative reference to the workmen and staff at the gas-works, who, he says, have rendered very satisfactory service during the year.

Extension of Greenbank Gas-Works.—The Town Clerk has reported to the Blackburn Gas Committee that the Ministry of Health have approved extensions to the Greenbank Gas-Works at an estimated cost of £53,061, and that sanction to the necessary borrowing powers will be given when the Ministry have been furnished with particulars of the amounts required, based on the tenders which the Corporation propose to accept. The Town Clerk submitted an application by the Pleasington Parish Council for discount to users of gas in Pleasington for early payment of accounts. The usual discount of 2½ p.ct. for early payment, it was stated, is allowed to all users outside the borough.

Further Reduction in Price at Cirencester.—Satisfactory progress was shown at the general meeting of the Cirencester Gas Company, Ltd., on Sept. 28. The revenue account for the year ended June 30 showed a profit on the working of £3486; and the Directors recommended final dividends at the rates of 12 p.ct., 6 p.ct., and £8 8s. p.ct. on the several classes of shares respectively, making 11 p.ct., 5½ p.ct., and £7 14s. p.ct. for the year. The gas sales have been well maintained, and a further reduction in the price of gas has been effected—the charge now being 1s. 1·34d. per therm, or 5s. per 1000 c.ft. It is hoped to enlarge the area of supply in the near future by embracing the villages of Siddington and South Cerney; and Parliamentary powers are being applied for to effect this.

Meltham Gasholder Accident Inquiry.—An explosion at the Meltham Gas-Works on Sept. 21, in which Richard Megson (28), of Westfield Road, Leeds, was fatally injured, was the subject of an inquiry, by Mr. E. W. Norris, the District Coroner, and a jury, at Huddersfield on Oct. 2. James Bradford, who was supervising the demolition of an old holder, said that most of the gas had been let out, and Megson was engaged in making a hole in the top with an axe, to let out the remainder. A spark from deceased's axe evidently ignited the escaping gas, which subsequently set alight the tar on the holder. Mr. Atkinson, Inspector of Factories, said he realized the danger of a spark being caused by the holder being struck with an axe, and thought that a drill would be a more desirable instrument for that kind of work. In returning a verdict of "Death by misadventure," the jury added that more detailed instructions should be given to the workmen as to how they should carry out such work.

Safety in Mines Research Board.—The second research station erected for the work of the Safety in Mines Research Board out of grants voted by the Miners' Welfare Committee from their Fund has just been completed at Sheffield. The first station, situated near Buxton, designed for carrying-out such experiments as large-scale explosions, was opened in June, 1927. The Sheffield Station consists of laboratories for small-scale experimental work, and the staffs of the two stations work as one unit. The establishment of these two stations is the last step in the efforts made for more than a century to apply the systematic methods of science to the solution of problems of the dangers of coal mining. A complete description of the Sheffield Laboratories is given in Safety in Mines Research Board Paper No. 44 (H.M. Stationery Office, 6d. net). It supplies (Part I.) a summary of the researches which are being carried out by the "S.M.R.B.," indicating how the various problems of the dangers of coal mining are systematically handled and their solution sought. It also contains (Part II.) a description of the new building and its equipment, and (Part III.) describes the research work at present in progress in the laboratories.

Steady Progress at Teignmouth.—The report of Mr. H. Higham, the Engineer and Manager of the Teignmouth Gas Department, on the working of the undertaking for the year ended March 31, states that the accounts show a credit balance of £3009—an amount greater by £2834 than that of the previous year. The output of gas has continued to grow, even after the exceptionally large increase of the previous year. The total sales amounted to 79,056,600 c.ft.—an increase of 4 p.ct.—while the number of consumers was greater by 92, there now being 2386. The new coal gas plant has worked very satisfactorily during the year. The amount of coal carbonized was 5020 tons; and 342 tons of coke and 16,208 gallons of oil were used for carburetted water gas manufacture. The total amount of gas made was 84,722,000 c.ft. In September last year the lighting of the central portion of the town was taken over from the Electric Lighting Company, and the gas lamps were reinstated. Together with other extensions, a new gasholder, which is being erected by Messrs. Robert Dempster & Sons, Ltd., of Elland, will be completed early next year. A reduction in the price of gas was effected from the beginning of March last of 1d. per therm, bringing the charge down to the present one of 1s. per therm.

Co-Partnership at Watford.—The general meeting of the Watford Gas and Coke Company's Co-Partnership Fund was held on Friday, Oct. 5, at the Gas-Works—Mr. E. J. Slinn (the Chairman of the Company) presiding. In moving the adoption of the report, the Chairman said that the balance brought forward, as shown on the withdrawable account for 1928, was £1492, and the contributions amounted to £661, as against £702 for 1927. At first glance that drop might appear to be due to less thrifty habits; but this could not be said, for during the first half of the year over £600 had been paid into the newly inaugurated Pension Fund. This fund was commenced on Jan. 1 last, but was not yet approved by the Board of Trade, because the Special Order had been held up pending the amalgamation with the St. Albans Gas Company. However, the Directors were hoping to obtain sanction shortly. There had been a ready response to the invitation to join the fund; and out of 215 eligible employees, 186 had already joined. The sum of £13,548 had been invested by the co-partners in stock since the commencement of the fund nineteen years ago. The bonus and interest paid amounted to £1323—an increase of nearly £100 on the previous year. On the motion of Mr. Slinn, seconded by Mr. A. Dolamore, the balance-sheet and report of the Committee, showing a balance in hand of £2764, was adopted. In conclusion Mr. Hollingsworth moved a hearty vote of thanks to the Chairman, which was seconded by Mr. W. S. Coles.

BY ORDER OF THE DIRECTORS.

NEW ISSUE OF 5% ORDINARY STOCK and 5% PERPETUAL DEBENTURE STOCK.

SOUTH SUBURBAN GAS COMPANY.

Incorporated by Act of Parliament, 1858, as the Crystal Palace District Gas Company.

Directors.

CHARLES CARPENTER, D.Sc., *Chairman.*
BENJAMIN R. GREEN, *Deputy Chairman.*
HAROLD GUNDRY.
FRANK BUSH.
FRANK H. JONES, M.Inst.C.E.
ARTHUR PADDON, M.Inst.C.E.
CHARLES J. CARTER.
ALEXANDER ROSS.

Chief Engineer.

JOHN TERRACE, M.Inst.C.E.

Commercial Manager and Secretary.

WILFRID WASTELL, F.C.I.S.

Bankers.

BARCLAYS BANK LIMITED.

PARTICULARS AND CONDITIONS OF SALE BY TENDER OF

£300,000 5 per cent. ORDINARY STOCK,

Minimum price £106 10s. 0d. per £100 Stock,

AND

£100,000 5 per cent. PERPETUAL DEBENTURE STOCK,

Minimum price £99 per £100 Stock,

to rank *pari passu* with the existing Stocks of the Company.

The Directors of the South Suburban Gas Company are prepared to receive on or before the 16th day of October, 1928, sealed tenders for £300,000 5 per cent. Ordinary Stock, and £100,000 5 per cent. Perpetual Debenture Stock.

The Stock may be tendered for in amounts of £10 or multiples thereof.

Tenders must be on the forms accompanying the Prospectus. No tender will be considered at less than the minimum prices stated above.

A deposit of 10 per cent. of the nominal amount of the Stock tendered for must accompany the tender, the balance of the purchase money of all Stock allotted to be paid to the Company's Bankers, Barclays Bank, Ltd., at any of their Branches, on or before the 31st October, 1928.

Dividend on the Ordinary Stock will commence to accrue from the 1st November, 1928, and the dividend to 31st December will be paid early in March, 1929. Interest on the Debenture Stock will commence to accrue from the 1st November, 1928, and interest to the 31st December will be paid on the 1st January, 1929. The Stock of the Company is quoted in the Stock Exchange Official List, and application will be made for the inclusion of the present issue.

The rapidly developing area supplied by the Company comprises 166 square miles, and includes parts of the Metropolitan Boroughs of Lewisham, Camberwell and Lambeth and the County Borough of Croydon, and the whole of Beckenham, Penge, Bromley, Orpington, Chislehurst, The Crays, Sidcup, Bexley, &c., and the important industrial districts of Crayford, Dartford and Erith.

The progress of the Company's business is indicated by the fact that during the past 5 years the sales of gas show an increase of 34½ per cent., whilst nearly 20,000 additional consumers have been secured during the period. The annual sales of gas approximate 19,000,000 therms, and the consumers number about 109,000.

The Company now ranks fourth amongst the Metropolitan and Suburban Gas Undertakings.

The paid-up Capital of the Company is as follows:—

	£
5 % Ordinary Stock	1,243,795
5 % Perpetual Debenture Stock	368,837
7 % Redeemable Debenture Stock (June, 1930)	101,200
	1,713,832
Premiums received on same	49,499
Total receipts to date	£1,763,331

and the balance of the authorized capital remaining to be issued totals £1,099,600.

The Reserve Fund on the 30th June, 1928, stood at £76,630 1s. 2d.

The dividends on the Company's Ordinary Stock have hitherto been subject to the operation of a sliding scale, by which the rate of dividend is directly affected by the selling price of gas. Under the South Suburban Gas Act, 1928, which comes into force on the 1st January, 1929, dividends payable on the Ordinary Stock will be calculated upon a basic rate of 5 per cent., plus a share of the profits, calculated in accordance with the Provisions of that Act.

It is anticipated that the rate of dividend, namely 6½ per cent. per annum, which has been paid upon the 5 per cent. Ordinary Stock during the past five years, will be fully maintained.

The Accounts of the Company are made up yearly to the 31st December, and dividends are payable half-yearly in March and August.

The yield of the Ordinary Stock at various prices would be:

	ORDINARY STOCK. Dividend at 6½ %
At 106½	£6 2 1
,, 107	6 1 6
,, 108	6 0 4
,, 109	5 19 3
,, 110	5 18 2
,, 111	5 17 1
,, 112	5 16 1

and the yield of the Debenture Stock would be:

	DEBENTURE STOCK. Interest at 5 %
At 99	£5 1 0
,, 100	5 0 0
,, 101	4 19 0
,, 102	4 18 0
,, 103	4 17 1
,, 104	4 16 2
,, 105	4 15 3

If tenders are received for a larger amount of Stock than that proposed to be issued, tenders at the lowest price accepted will be subject to diminution.

All Stock allotted when fully paid will be registered in the Company's books, and certificates issued, free of expense, in the name of the person tendering, or his or her nominee, after which it will be transferable by deed in the usual way.

If no allotment is made, the deposit will be returned in full; and in case of partial allotment, the balance of the deposit will be applied to the balance of purchase money due.

Interest at the rate of 10 per cent. per annum will be chargeable upon any balances of purchase money unpaid by the 31st October, 1928.

Tenders must be delivered by or before 12 o'clock noon on Tuesday, 16th October, 1928.

Copies of this Prospectus may be obtained at the Head Offices of the Company, Lower Sydenham, S.E. 26, at any of the Showrooms as under:—

2, DARTMOUTH ROAD, FOREST HILL, S.E. 23
53, WESTOW HILL, NORWOOD, S.E. 19
11, HIGH STREET, SOUTH NORWOOD, S.E. 25
24, HIGH STREET, BECKENHAM
156, HIGH STREET, BROMLEY, KENT
86A, STATION ROAD, SIDCUP
14, PIER ROAD, ERITH
4, HYTHE STREET, DARTFORD

at Branches of Barclays Bank, Ltd., or from MESSRS. SEYMOUR PIERCE & Co., 5, Lothbury, E.C. 2.

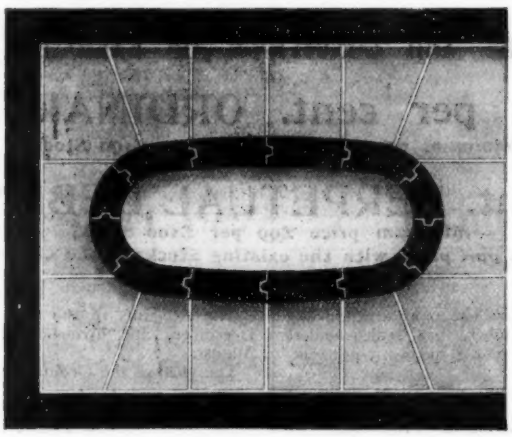
By Order of the Board,

WILFRID WASTELL,
Commercial Manager and Secretary.

HEAD OFFICES OF THE COMPANY,
LOWER SYDENHAM, S.E. 26.
6th October, 1928.

THE GLOVER-WEST SYSTEM OF VERTICAL RETORTS

Correct in Principle Perfect in Detail



FIRST AND FOREMOST—

¶ 1 *The Retort.*

Constructed of the best silica materials, perfectly moulded, elliptical in cross section.

The arch-like shape of the retort walls gives the retort a natural rigidity, rendering stays unnecessary.

Further, the retort in section possesses no sharp corners across which the charge would "bridge" or "arch over."

Consequently all classes of coal pass evenly down the retort without sticking or hanging up.

West's Gas Improvement Co. Ltd.

MILES PLATTING · · · MANCHESTER

Telephones:—
CENTRAL 5961 (3 lines)

Telegraphic Address:—
"STOKER, MANCHESTER."

LONDON
REGENT HOUSE, KINGSWAY, W.C.2
Telegraphic Address:—
"IMVERTRET, WESTCENT, LONDON"
Telephone:—
HOLBORN 4108

SYDNEY
UNION HOUSE, 243, GEORGE STREET, SYDNEY, N.S.W.
Telegraphic Address:—
"VERTICAL, SYDNEY."

NEW YORK (U.S.A.)
WEST GAS IMPROVEMENT CO. OF AMERICA Incorporated
441, LEXINGTON AVENUE, New York
Telegraphic Address:—
"VERTICALS, NEW YORK."
Telephone:—MURRAY HILL 7242.

PARIS
CIE. GLE. DE CONSTRUCTION DE FOURS,
8, Place des Etats-Unis, MONTROUGE (Seine).
Telegraphic Address:—
"CORMIQUES-MONTROUGE (SEINE)."
Telephone:—SEGUR 92-63 & 92-64.

STOCK MARKET REPORT.

DESPITE the disturbing rumour of a Treasury issue of some £200,000,000 3 p.ct. five-year Treasury Bonds and the outflow of gold to America, the gilt-edged market maintained a firm front last week, and, apart from a slight weakening in 3½ p.ct. Conversion and 4 p.ct. Funding Loans, values improved.

It will be seen by the Table that Gas Stocks were well supported. Primitiva ordinary eased off 1s. to 25s. 6d.-27s. 6d.; but otherwise all the variations in ordinary stocks were in an upward direction. Hastings 5 p.ct. consolidated made a spectacular jump of 7 points; the 3½ p.ct. consolidated advanced 4½ points to 75-80; and British ordinary rose 3 points to 114-117. All three stocks are sound investments at the enhanced prices.

Investors in gas stocks are reminded that tenders will be received up to Oct. 16 in respect of the South Suburban Company's issue of £300,000 5 p.ct. ordinary stock at a minimum of 106½, and of £100,000 5 p.ct. perpetual debenture stock at 99. The present quotation of the former is 106-109, and the latter 97-100. The dividend on the ordinary stock has been 6½ p.ct. for the past five years, and there appears to be no reason why this rate should not be maintained.

Issue.	Share.	When ex-Dividend.	Dividends, Prev. Hf.Yr	Dividends, Last Hf. Yr.	NAME.	Quotations. Oct. 5.	Rise or Fall on Week.	Transactions Lowest and Highest Prices.
£			%p.a	% p.a.				
171,978	Stk.	Aug 30	5	5	Aldershot 5 p.c. max. C.	72—77	..	..
412,992	,,	,,	4	4	Do. 4 p.c. Pref.	68—71	..	..
1,551,868	,,	Sept. 27	7	7½	Alliance & Dublin Ord.	95—98*	..	94½—97½
374,000	,,	July 12	4	4	Do. 4 p.c. Deb.	63—66	..	63
522,654	,,	Aug. 30	7	7	Barnet Ord. 7 p.c.	109—112	..	..
300,000	1	Apl. 26	1/7½	1/7½	Bombay, Ltd.	21/—23/-	..	..
170,000	10	Aug. 30	8½	8½	Bournemouth 5 p.c.	12½—13½	..	..
500,050	10	,,	7	7	Do. B 7 p.c.	12½—12⅝	..	..
375,000	10	,,	6	6	Do. Pref. 6 p.c.	10¼—11⅛	..	11⅛—£11/6/9
50,000	Stk.	July 12	3	3	Do. 3 p.c. Deb.	56—59	..	..
162,025	,,	,,	4	4	Do. 4 p.c. Deb.	75—78	..	77⅝
357,900	,,	Aug. 30	7½	7½	Brighton & Hove 6 p.c. Con.	114—117	..	..
341,880	,,	,,	6½	6½	Do. 5 p.c. Con.	101—104	..	..
1,287,500	,,	July 26	5	5	Bristol 5 p.c. max.	90½—91½a	..	..
885,000	,,	Sept. 27	7	8	British Ord.	114—117*	+3	114½—116½
100,000	,,	June 28	7	7	Do. 7 p.c. Pref.	114—117	..	115
120,000	,,	,,	4	4	Do. 4 p.c. Red. Deb.	74—77	..	..
200,000	,,	,,	5	5	Do. 5 p.c. Red. Deb.	95—98	..	..
100,000	10	May 24	6	8	Cape Town, Ltd.	8—9	..	..
100,000	10	Apl. 26	4½	4½	Do. 4½ p.c. Pref.	6¾—7½	..	..
150,000	Stk.	June 28	4½	4½	Do. 4½ p.c. Deb.	73—78	..	..
626,860	,,	July 26	6	6	Cardiff Con. Ord.	96—99	..	..
287,860	,,	June 28	7½	7½	Do. 7½ p.c. Red. Deb.	100—103	..	..
157,150	,,	Aug. 16	6⅔	5	Chester 5 p.c. Ord.	88—93b	..	..
79,185	1	Apl. 26	1⅔/-	1⅔/-	Colombo Ltd. Ord.	36/—38/-	..	..
24,495	1	,,	1/4⅔	1/4⅔	Do. 7 p.c. Pref.	21/—23/-	..	..
375,402	1	Apl. 12	1/9⅔	1/9⅔	Colonial Gas Assn. Ld. Ord	23/—25/-	..	..
187,848	1	,,	1/7½	1/7½	Do. 8 p.c. Pref.	21/—23/-	..	..
2,073,280	Stk.	July 26	7	5	Commercial Ord.	98—101	..	98½—99⅞
475,000	,,	June 14	3	3	Do 3 p.c. Deb.	57—60	..	58½—59½
600,000	,,	Sept. 27	11	11	Continental Union, Ltd.	30—35*	..	31½—34
200,000	,,	,,	7	7	Do. 7 p.c. Pref.	90—95*	..	92½
787,560	,,	Aug. 16	7	7	Croydon sliding scale	109—112	..	108—109
402,100	,,	,,	5	5	Do. max. div.	84—87	..	84—85
492,270	,,	Aug. 16	10	7	Derby Con.	115—120c	..	..
55,000	,,	June 28	4	4	Do. Deb.	71—73c	..	..
209,000	,,	Aug. 30	5	5	East Hull Ord. 5 p.c.	75—78	..	..
50,000	,,	June 28	5	5	Eastbourne 5 p.c. Deb.	94—97	..	..
1,002,180	10	Sept. 13	†6	†4	European, Ltd.	8—9*	..	8⅝—8¾
18,708,480	Stk.	July 26	5/1¼	5½	Gas Light & Coke 4 p.c. Ord.	19/4½—19/10½f	..	19/4½—19/9
2,600,000	,,	,,	3½	3½	Do. 3½ p.c. max.	62—64	..	63½—64
4,157,020	,,	,,	4	4	Do. 4 p.c. Con. Pref.	77—80	..	78—79
5,602,620	,,	June 14	3	3	Do. 3 p.c. Con. Deb.	61—63	..	61½—62½
181,315	,,	,,	6	6	Do. 6 p.c. Br'tf'd Rd. Db.	103—106	..	..
1,642,770	,,	,,	5	5	Do. 5 p.c. Red. Deb.	99—101	..	99½
42,000	,,	—	7½	7½	Do. 7½ p.c. Ilford Deb.	..	..	..
82,500	,,	Aug. 30	6½	7	Hastings & St L. 5 p.c. Conv	95—100	+7	..
258,740	,,	,,	5½	5½	Do. 3½ p.c. Conv.	75—80	+4½	..
70,000	10	Apl. 26	†10	†10	Hongkong & China, Ltd.	13½—14½	..	..
173,200	Stk.	Aug. 30	5	5½	Hornsey Con. 3½ p.c.	85—87	..	..
1,976,000	,,	May 24	10	10	Imperial Continental Cap.	171—176	..	173—175
223,130	,,	Aug. 16	3½	3½	Do. 3½ p.c. Red. Deb.	67—69	..	68½—69
235,242	,,	Aug. 16	7	7½	Lea Bridge 5 p.c. Ord.	98—101	..	..
2,145,907	,,	Aug. 16	5½	5½	Liverpool 5 p.c. Ord.	90—91b	..	..
600,000	,,	Sept. 27	7	7	Do. 7 p.c. Red. Pref.	102½—103½b	+1	..
165,736	,,	Aug. 16	8	9	Maidstone 5 p.c. Cap.	112—117	..	..
63,480	,,	June 14	3	3	Do. 3 p.c. Deb.	55—58	..	..
75,000	5	June 14	†8	†8	Malta & Mediterranean	5½—6	+½	..
541,920	Stk.	May 24	†5	†7	Montevideo, Ltd.	95—98	..	96½
2,051,315	,,	Aug. 16	5	5	Newcastle & Gateshead Con.	16/3—16/9d	..	..
380,929	,,	,,	4	4	Do. 4 p.c. Pref.	71½—72½d	−1	..
691,705	,,	June 28	3½	3½	Do. 3½ p.c. Deb.	69½—70½	..	..
131,780	,,	Aug 30	6/18/0	7/1/0	North Middlesex 6 p.c. Con.	96—99	..	..
300,000	,,	Apl. 26	9	7	Oriental, Ltd.	115—118	..	..
188,120	,,	June 28	7½	7½	Plym'th & Ston'house 5 p.c.	107—112	..	..
414,500	,,	Aug. 30	7½	7½	Portsm'th Con. Stk. 4p.c. Std.	101—104	..	..
286,782	,,	,,	5	5	Do. 5 p.c. max.	79—82	..	..
2,334,464	1	—	—	—	Primitiva Ord.	25/6—27/6	−1/-	25/6—27/6
244,500	100	June 1	4	4	Do. 4 p.c. Red. Deb.	91—94	..	..
695,000	Stk.	July 26	4	4	Do. 4 p.c. Red. Deb. 1911	78—80	..	..
416,345	,,	June 28	4	4	Do. 4 p.c. Cons. Deb.	78—80	..	..
150,000	10	Sept. 27	6	6	San Paulo 6 p.c. Pref.	8½—8¾*	..	..
270,000	Stk.	Aug. 30	6	6½	Sheffield A	103½—104½c*	..	..
419,968	,,	,,	6	6½	Do. B	103½—104½c*	..	..
1,047,000	,,	,,	6	6½	Do. C	103½—104½c*	..	..
20,000	10	June 14	‡3	‡4	South African	3—6	..	..
6,609,895	Stk.	July 26	7½	5	South Met. Ord.	107—109	+1	107—108½
500,000	,,	,,	6	6	Do. 6 p.c. Irred. Pf.	110—113	..	111½—112½
1,895,445	,,	July 12	3	3	Do. 3 p.c. Deb.	59—61	..	..
734,000	,,	Sept. 13	6½	6½	Do. 6½ p.c. Red. Db.	100—102	+1	..
91,500	,,	Aug. 16	8½	8½	South Shields Con.	108—110d	..	..
1,243,795	,,	July 26	6½	6½	South Suburban Ord. 6 p.c.	106—109	..	108—109
368,837	,,	June 28	5	5	Do. 5 p.c. Deb.	97—100	..	98½
647,740	,,	Aug. 30	5	5	South'mpton Ord. 5 p.c. max.	77—79	..	..
121,275	,,	June 28	4	4	Do. 4 p.c. Deb.	72—75	..	..
250,000	,,	Aug. 30	7	7	Swansea 7 p.c. Red. Pref.	100—102	..	..
200,000	,,	June 28	6½	6½	Do. 6½ p.c. Red. Deb.	100—102	..	101
120,000	,,	July 26	7½	8	Tottenham District A 5 p.c.	117—123	..	..
882,275	,,	,,	6½	6½	Do. B 8½ p.c.	99—102	..	..
150,000	,,	,,	5½	5½	Do. 5½ p.c. Pref.	96—99	..	..
181,255	,,	June 14	4	4	Do. 4 p.c. Deb.	76—79	..	..
289,094	,,	Aug. 30	6.5a	6⅞	Uxbridge, Maidenhead, & Wycombe 5 p.c.	90—95	..	93—94
88,230	,,	,,	5	5	Do. 5 p.c. pref.	87—92	..	..
80,000	,,	July 12	8½	8½	Wandsworth, Wimbledon, and Epsom— Wandsworth A 5 p.c.	126—129	..	..
255,636	,,	,,	7	7½	Do. B 5½ p.c.	108—113	..	..
432,585	,,	,,	5/19/0	6½	Do. C and New	96—101	..	..
852,000	,,	,,	6⅝	6⅞	Do. Wimbledon 5 p.c.	104—109	..	..
98,000	,,	,,	7⅛	7⅛	Do. Epsom 5 p.c.	110—115	..	..
200,000	,,	,,	5	5	Do. 5 p.c. Pref	88—91	..	..
88,416	,,	June 28	3	3	Do. 3 p.c. Deb.	56—59	..	..
284,748	,,	,,	4	4	Do. 4 p.c. Deb.	75—78	..	..
207,500	,,	,,		5	Do. 5 p.c. Deb.	98—100	..	..

Quotations at:—a.—Bristol. b.—Liverpool. c.—Nottingham. d.—Newcastle. e.—Sheffield. f.—The quotation is per £1 of Stock. * Ex. div. † Paid free of income-tax. ‡ For year.

The following transactions were recorded during the week:

On Monday, Bournemouth 6 p.ct. preference 11⅛, British 116, Continental Union 31½, 32, 33⅛, 7 p.ct. preference 92¼, European 8 5/16, 8½, Gas Light and Coke 19s. 6d., 19s. 8¼d., 19s. 9d., 3½ p.ct. maximum 63⅜, 63⅝, 4 p.ct. preference 79, Imperial Continental 173, 174, 174¼, 175, 3½ p.ct. debenture 68½, Newcastle 4 p.ct. preference 72, Primitiva 26s. 7½d., 26s. 9d., 26s. 10½d., 27s., 27s. 1½d., 27s. 6d., South Metropolitan 107½, Uxbridge 5 p.ct. 93, 94. Supplementary prices, Gas Light and Coke 5 p.ct. debenture 1952-57 101¼, Swansea 5 p.ct. maximum 78.

On Tuesday, Alliance and Dublin 97, 97⅞, Bournemouth 6 p.ct. preference £11 6s. 9d., Cambridge University 5 p.ct. debenture 90½, Commercial 98½, European 8⅜, 8 5/16, Gas Light and Coke 19s. 6d., 19s. 8¼d., 19s. 9d., 4 p.ct. preference 78½, 3 p.ct. debenture 62½, 5 p.ct. debenture 99½, Imperial Continental 173¼, 175, 3½ p.ct. debenture 69, Primitiva 26s., 26s. 1½d., 26s. 3d., 26s. 6d., 26s. 7½d., 26s. 9d., South Metropolitan 107, 108, 6 p.ct. preference 112, 112½. Supplementary prices, Gas Light and Coke 5 p.ct. debenture 1952-57 101½, Liverpool 5 p.ct. 90½.

On Wednesday, Alliance and Dublin 96¼, 97, 4 p.ct. debenture 63, Bournemouth 4 p.ct. debenture 77⅝, British 114½, 115, 115½, 7 p.ct. preference 115, Cambridge University 5 p.ct. debenture 96¼, Commercial 3 p.ct. debenture 58½, Croydon sliding-scale 108, 109, maximum dividend 84, 85, Gas Light and Coke 19s. 4½d., 19s. 6d., 19s. 7½d., 19s. 8¼d., 19s. 9d., 4 p.ct. preference 78, 78¼, 78⅜, 3 p.ct. debenture 61½, Montevideo 96½, Primitiva 25s. 7½d., 25s. 9d., 26s., 26s. 1½d., 26s. 3d., 26s. 6d., South Metropolitan 107⅜, 108¼, South Suburban 109. Supplementary prices, British, Norwich, 4 p.ct. debenture 77, Folkestone 80½, Gas Light and Coke 5 p.ct. debenture 1952-57 101¼, Hornsey new 5 p.ct. preference 88½, Liverpool 5 p.ct. 91, Uxbridge 4 p.ct. debenture 75, Worthing 96, 96½.

On Thursday, Alliance and Dublin 94 11/16, British 115⅜, Commercial 98½, 99, Continental Union 33⅛, 34, Gas Light and Coke 19s. 4½d., 19s. 6d., 19s. 7½d., 19s. 8¼d., 19s. 9d., 3½ p.ct. maximum 63¼, 63⅜, 64, 4 p.ct. preference 78⅜, 3 p.ct. debenture 61⅛, Imperial Continental 173, 173⅛, 174½, Primitiva 25s. 7½d., 25s. 9d., 26s., 26s. 1½d., South Metropolitan 107¼, 107½, 107⅝, 107⅞. Supplementary prices, Brighton and Hove 6 p.ct. "B" preference 108, Folkestone 80, Gas Light and Coke 5 p.ct. debenture 1952-57 101¼, Liverpool 5 p.ct. 91, Metropolitan (of Melbourne) 5¼ p.ct. debenture 99½, 100¼, Newport (Mon.) 5 p.ct. 79.

On Friday, Alliance and Dublin 97½, British 114½, 115⅜, 116⅛, Commercial 99½, 99⅞, 3 p.ct. debenture 59½, Gas Light and Coke 19s. 4½d., 19s. 6d., 19s. 7½d., 19s. 9d., 3½ p.ct. maximum 63⅜, 63⅝, 64, Imperial Continental 174, Primitiva 25s. 6d., 25s. 9d., South Metropolitan 107, 107½, 107⅝, 6 p.ct. preference 111⅜, 112½, South Suburban 108, 5 p.ct. debenture 98½, Swansea 6½ p.ct. debenture 101. Supplementary prices, Cheltenham 5 p.ct. maximum 73⅜, Gas Light and Coke 5 p.ct. debenture 1952-57 101¼, Liverpool 5 p.ct. 91, Swansea 5 p.ct. maximum 78½.

The large shipment of gold to New York caused a revision in Treasury Bill tenders, which resulted in an increase in the average rate, as compared with the previous week, of nearly 1s. 3d. p.ct. to £4 5s. 11·57d. p.ct., and discount rates firmed up in consequence. Money rates were generally 3½ p.ct. for both old and new loans, but declined to 3¼ p.ct. towards the close.

A feature of the Foreign Exchange Market was the demand for Italian lire, the rate declining 11c. to 92.56¼. The dollar-sterling was slightly firmer at 4.84⅞; French francs were cheaper at 124.07½; pesetas closed at 29.78; German marks moved against sterling to 20.35¾; Belgas were dearer at 34.89¼; and Dutch florins remained unchanged at 12.09 5/16.

Silver, with India and China both buying, rose to 26¾d. per oz., and Gold was unaltered at 84s. 11½d. per oz.

The Bank Rate is 4½ p.ct., to which it was reduced from 5 p.ct. on April 21, 1927. The Banks' deposit rate is 2½ p.ct., and the deposit rates of the discount houses are 2½ p.ct. at call and 2¾ p.ct. at notice.

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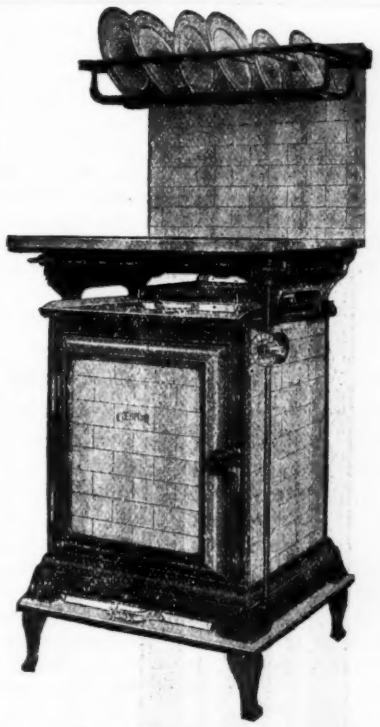

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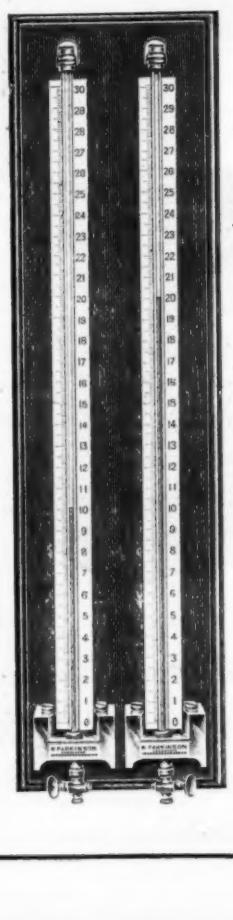

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